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THE FOUNDRY

Vol. 34, No. 4 CLEVELAND, OHIO, JUNE, 1909 Whole No. 202

FOUNDRYMEN'S MEETING AT CINCINNATI

Report of the convention proceedings of the American Foundrymen's Association and allied organizations, entertainment features and other events of Founders' Week

FOUNDERS' WEEK, fittingly celebrated in Cincinnati May 17 to 22, was marked by a record-breaking attendance of more than 2,000 foundrymen, who journeyed not only from all parts of the United States and Canada, but Sweden, Austria-Hungary and Germany as well. The attractions included the fourteenth convention of the American Foundrymen's Association, the annual meetings of the American Brass Founders' Association and the Associated Foundry Foremen, as well as the exposition of foundry supplies and equipment, conducted under the auspices of the Foundry and Manufacturers' Supply Association in Music Hall. That the technical features of foundry practice are being given more attention by manufacturers of castings generally was indicated by the interest manifested in the proceedings of the various educational organizations, and the discussions of the numerous papers presented developed many points of interest. The exhibitions, more numerous and elaborate than heretofore, attracted much attention throughout the week. The main floor of Music Hall, where foundry equipment and supplies were displayed, as well as the temporary building adjoining, in which brass melting furnaces were shown, were constantly crowded, and several Cincinnati shops were closed for one day to enable their employes to visit the show. The entertainment provided measured up to the hospitality for which the Queen City is noted, and included a reception at the Hotel Sinton on Tuesday evening and a boat ride on the Ohio river, with a visit to "Coney Island" on Thursday afternoon and evening. No less than 1,200 foundrymen and guests were enrolled at the time of the opening session, held in Music Hall on Tuesday afternoon. President L. L. Anthes, in his annual address dwelt on the harmonious relations existing between the parent and affiliated organizations and emphasized the vital necessity for the continuance of these feelings if the associations would accomplish the best results for their members Continuing, he spoke as follows:

ARTHUR T. WATERFALL
President, A. F. A.

"The educational features and technical requirements of all branches of industrial trade are appealing to the world today as they never did before. The necessity of a deeper knowledge—a more comprehensive grasp of the laws of nature which bear upon industrial development—are felt, and international competition demands that America must not be backward to encourage this development. Especially is this so of the metal industries—the greatest of all American industries—and which yet holds many secrets to be worked out in the laboratory and in the foundry, and more particularly by the practical man who superintends and upon whom depends the results to be obtained from the intelligent application of what he knows regarding the raw materials at his hand. So much centers upon some little detail, and many an experiment has been given up as a failure because that one little detail was not mastered. It may have been the iron, it may have been the sand that was at fault, the experimenter did not know. He possibly had the analysis of the iron (the A. F. A. was responsible for that), but what about his sand? It came from the same heap he had drawn from for years; beyond that he knew nothing about it; another opportunity for the A. F. A., and here comes a delicate point. The American Foundrymen's Association was created to solve difficulties for the foundryman, but it must be borne in mind that the solution of these

difficulties cannot be arrived at with an empty treasury. Experiments cost money and without money we can have no experiments, and without experiments no results. Some months ago, in accordance with a resolution passed at our last annual meeting, the members were called upon to vote for or against the raising of the annual fee of $5.00 to $10.00. It was felt, and also proven, that the sum of $5.00 per capita did not begin to meet the requirements of our increasing work. The result of the canvass was not altogether satisfactory. Though the majority of those from whom replies were received voted in favor of the raise in dues, the total vote was insufficient, as it did not represent two-thirds of our membership, such as is necessary to amend the constitution. I do not wish to assume the attitude of preacher exhorting his flock to loosen their wads for the salvation of the distant heathen. This is a business proposition. The fee you annually pay is not a contribution; it is an investment, and if it were not a paying investment you would not be here. You are helping to sustain the life of your own trade and no life should be sacrificed merely because it costs money to live. The A. F. A. is the hub of foundry progress, and we surely will not stop the chariot of state because we are stingy with the axle grease.

L. L. ANTHES
Retiring President, A. F. A.

RICHARD MOLDENKE
Secretary, A. F. A.

JOSEPH T. SPEER
Vice-President, A. F. A.

W. R. WEBSTER
President, A. B. F. A.

W. M. CORSE
Secretary, A. B. F. A.

Endowed Laboratory.

"Dr. Moldenke and myself made it a point to wait upon the National Founders' Association which met in convention in New York last November, and upon the approval of our executive committee asked that body to confer with us on the advisability of establishing an endowed laboratory and bureau of standardization for the metal industries. The members of the N. F. A. approved of the move and appointed a committee to act in conjunction with our committee. Owing to the unsettled condition of industrial and financial affairs during the past year, it was deemed advisable to lay the matter over until times were more encouraging. Just how an endowed fund for this work is to be raised is an unsolved question.

"Every year—probably every day—something new is being learned of metallurgy and its industrial applications. An important discovery may be made amidst the most humble surroundings, a discovery which may be of great service to the trade at large and which could be imparted by the discoverer to his fellow men without any commercial loss to himself. But how is this discovery to be made known, when it is something that requires further investigation and experimenting, but where the discoverer lacks the necessary funds, time, equipment or training to carry along his work to a conclusive issue? Things are at a standstill and something is lost which possibly might have saved millions in money. We are a wasteful people because we have not learned to conserve our natural resources and many a dollar goes to the dump because of our ignorance. Now, if we had a bureau where reports of discoveries could be made to practical men, the necessary attention could be given, and in many cases beneficial results obtained. The United States Steel Corporation has recognized the importance of investigation and is operating an experimental plant to further its own commercial requirements. If we possessed a similar plant, perhaps not quite so pretentious, a record could be kept of experiments and investigations, and any discovery that has been made or affirmed could be published in our trade papers or a journal distributed by the bureau for the benefit of the foundry trade. Added to this the various details of foundry practice could be standardized and formulae issued in the shape of a hand-book, to be used by the foundrymen as a practical guide to his work. Good technical literature properly prepared is an invaluable aid to the progressive operator of a plant.

Books on Foundry Practice.

"We all approve of technical schools, recognizing the necessity of training young men to practically apply the knowledge that has been imparted to them. But, of first importance is the necessity of imparting correct knowledge. Let the textbooks of these technical schools be compiled by men who have had practical experience, and let the contents of these books be the very latest and best proceedure relating to the trade they are endeavoring to master. Had we a bureau, manned by men who were qualified to conduct experiments and compile these textbooks, we could be confident that the training these students were getting at the technical schools was in accordance with up-to-date foundry

practice. It is the thirst for knowledge, the desire to know what others are doing, that brings the foundrymen together year after year. This is the progressive spirit and the more numerous the channels for distributing knowledge the more rapid the progress.

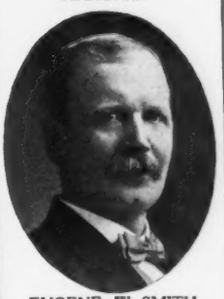
"It is only by an educational campaign such as is being carried on by the A. F. A. and allied organizations, that the young foundryman is going to reap advantages that his father never dreamed of. All honor to the pioneers of our trade. They worked out the problems and prepared the way, and we of the younger generation are getting the benefits.

Convention Spirit.

"One great and good feature of our gatherings cannot be overlooked and that is the goodfellowship and broadmindedness the conventions encourage and develop. We no longer cling tenaciously to trade secrets and close our shops to all-comers in search of knowledge. This selfish, and I may say barbarian spirit is gradually dying out and a more liberal attitude is being taken by the foundryman toward his fellows.

"Foundrymen, like followers of other trades, have been held back by what may be termed hide-bound superstitions regarding what can and what cannot be done in the molding shop. They had been used to certain conditions and it was like losing a dear relative to break away from these conditions. Yet the foundrymen were not to blame, they were doing the best they could and it was not until they got more light that they could see more plainly. A hide-bound foundryman has to be handled very much as the missionary handles the heathen, and then often the convert is more zealous than the missionary. When a man begins to see beyond the confines of his own shop, to recognize that he is not a slave to existing conditions, then he begins to see possibilities that he never before realized. But you must try to catch the foundryman young to turn his mind into progressive channels while it is in the formulative state. He is a much harder proposition when his mind is set. It was only last night that I heard a foundryman claim that he had no use for the foundry chemist, that he would rely on his judgment of fracture every time and then in practically the same breath this man declared that he was "too antiquated" to take up these new things. Here was a confession in an honest, outspoken manner, and the fact that he wished to convey contained far more truth than one might imagine. It bore out the time-worn proverb, 'It is hard to teach an old dog new tricks.'

C. J. CALEY
Retiring President
A. B. F. A.



EUGENE W. SMITH
President, A. F. F.

C. E. HOYT
Secretary
F. & M. S. A. and A. F. F.

W. S. McQUILLIN
Retiring President, A. F. F.

WM. GILBERT
Treasurer
Cincinnati General Committee

Molding Machine.

"One of the most notable advances in the development of the foundry has been the introduction of the molding machine. What it has already accomplished, covering a wide variety of work, is known to the majority of you and is being demonstrated at this convention. But I wish to state to you that the use of the molding machine has been limited by our own limited knowledge of foundry practice. The more facts we learn regarding the physical properties of the elements we work with, the more efficient will we find the molding machine. Owing to our scanty knowledge of the properties of molding sand alone, we are incapable of applying the molding machine to work that will ultimately be taken care of by this great factor in economical operation. During the past year I might incidentally point out that Dr. Moldenke has been making careful experiments with molding sand from all parts of the country, and has prepared a tabulated report of his work which will be laid before you. Another serious problem that faces the molding machine man is, 'What is the most economical and efficient way to handle the molds turned out by the machine?' The true economic value of the machine cannot be determined until the machine is worked to capacity; and I ask the question, 'Are our facilities adequate to work our molding machines to their limit?' I am afraid not. To assist our members to the solution of this problem we have endeavored, and with a degree of success, to obtain papers along this line from the best authorities upon the speedy handling and pouring of molds. Continuous pouring and sand conveying has been adopted by a number of large plants in order to economize floor space, equipment and labor and we are pleased to state that we will have addresses from men who have treated the possibilities of continuous pouring. These papers I trust will bring out good discussions and I wish to emphasize my belief that the discussions are the life of our

meeting."

Mr. Webster's Address.

In the absence of Charles J. Caley, president of the American Brass Founders' Association, W. R. Webster, Bridgeport, Conn., first vice president, delivered the welcoming address for that organization. Mr. Webster made the suggestion that the best way to insure the progress of their organization was to obtain an ample supply of papers on a wide variety of subjects, and advocated the appointment of a committee to secure these. One epigrammatic remark he made was that "Experience has proven that those who have most fear of imparting knowledge are usually in most need of it." The suggestion that permanent committees should be appointed to secure the establishment of proper standards of various kinds, was urged.

Secretary W. M. Corse, of the Brass Founders' Association, in his report announced that arrangements had been completed for giving to the association the right to use the metallurgical abstracts from the *Journal* of the American Chemical Society. He also made the suggestion that a committee be appointed to compile standard methods of analysis for brass and kindred alloys, and added that the United States Bureau of Standards, as well as the standing committee of the American Chemical Society on "Standard Methods of Analysis," had signified willingness to co-operate with them in the work. Both organizations, he said, would have representatives at the convention to consult, if necessary, with any committee appointed by the Brass Founders. The financial report of the Brass Founders' Association showed a balance in the treasury of $148, which included $130 received as dues for the ensuing year, received since the report was compiled. Receipts during the year were $1,042.64, and expenses $1,024.64. The number of members is 201.

Secretary's Report.

The report by Dr. Moldenke, secretary and treasurer, was in part as follows:

"It is but natural that the period of depression through which the foundry industry is passing, should in a great measure be reflected in a statement of the condition and activity of the association. And yet, in spite of the difficult collections, and the great number of members not in good standing at the present time, interest in the work of our association is on the increase, and the information disseminated is no longer falling on so much barren ground as formerly. The enormous attendance at our conventions, stimulated without doubt by the magnificent working exhibits—a tribute to the educational tendencies of the day—is bringing about an interchange of thought on desirable lines of foundry progress, the outcome of which we see reflected in our convention program. Probably two lines of foundry economy have been more or less studied during the last year, and they are the permanent mold, with the elimination of economic waste where success has obtained; and continuous melting, with the resulting output increase in existing plant units.

JAMES A. GREEN
Chairman
Cincinnati General Committee

GEO. McG. MORRIS
Chairman
Cincinnati Finance Committee

THEO. BOLLMANN
Finance Committee

LEWIS WALTER
Finance Committee

WALTER GEIER
Finance Committee

Progress in the Foundry.

"The correspondence passing through the secretary's office has reflected the above mentioned tendencies rather sharply, and would seem to indicate that before long we will find foundrymen understanding their cupolas better, and manipulating them to suit their floor conditions instead of the reverse. The permanent mold will probably still further specialize in the foundry, gradually drawing from the general trade those certain castings which have to be made cheaply and in quantity. Separate plants, of comparatively small size, but enormous capacity, fully equipped to do just one line of work, turning scrap into finished castings of uniform composition and specified service requirements, will be located where the proper commercial conditions obtain, and another chapter added to the growing volume on modern foundry practice.

Membership.

"Deducting from our membership list those whose case may be termed hopeless, we have today 724 firms and individuals enrolled, the majority of whom we have been able to serve during the year with foundry information of one kind or another, in addition to the regular channel of *Transactions*. The pleasant, though onerous work thus entailed has naturally militated strongly against proper attention to reviewing the technical press for the benefit of all our membership, as well as the conduct of the research work outlined last year. The value, however, to those whom we have thus assisted, evidently prompted many,

when sending in their votes for increased dues, to remark that the money thus spent was their best paying investment.

Dues Not Increased.

"Agreeable to resolution by the Toronto convention, ballots were sent out recently, asking for a vote on the proposed increase in annual dues to $10. The purpose was fully explained in an accompanying circular; 143 votes in favor were received, 44 against. The affirmative being less than the two-thirds vote of the entire body required, the proposition failed of acceptance. While this is much to be regretted, evidently the hard times are to blame. Of the affirmative votes, there were but few in which there was not added some commendatory remark, thus encouraging your executive board greatly, and giving valuable suggestions. One point seemed to stand out specially—a desire to have a bound volume of the *Transactions* at the end of each year, as is the custom of the great engineering societies. Were our finances ample, this would be a very fine thing to do."

Financial Report.

Income from dues and subscriptions to *Transactions*	$2,635.15
Balance from last year.....	37.74
Total	$2,672.89
Expenditures, for *Transactions*..	$ 765.60
Expenditures, for printing.....	209.38
Expenditures, for salaries.....	900.00
Expenditures, for postage.....	432.00
Expenditures for accident committee	215.61
Expenditures, for Toronto Convention	142.36
Total	$2,664.95
Balance	$ 7.94

Committee on Accidents.

Only one of the committees appointed at the Toronto meeting reported on its year's work at this session. This was the committee on "Prevention of Accidents in Foundries," Thomas D. West, chairman. Letters were sent to 6,336 foundries early in the year, and the total number of accidents reported by 1,084 firms was 5,242, 11 of which were fatal. Mr. West made the following suggestions for the prevention of accidents, which he thought, if adopted, would result in greatly reducing the number of accidents:

FRED S. BRUNNER
Finance Committee

J. K. POLLOCK
Chairman
Entertainment Committee

H. F. FROHMAN
Entertainment Committee

F. M. EATON
Entertainment Committee

JOHN SARGENT
Entertainment Committee

(1) Weekly or monthly close inspection of all chains, slings, hooks and ladle bows, etc. This by competent persons, properly reporting to the office. A yearly or semi-annual annealing of chains.

(2) Clean tools and an orderly arrangement of all shop appliances. The compelling of all employes to keep everything in its allotted place when not in use.

(3) Well lighted shops. Especially on dark days and at night to have lights powerful enough to penetrate steam and dust, and yet give no sharp shadows on the floors.

(4) The use wherever practicable of tram-ways to carry molten metal from the cupola to the floors. When this is not possible, loose earth should be provided about the cupola spout, side-tapping being preferable. (This because the greatest number of accidents by burns are said to occur there.)

(5) Requiring carriers of molten metal to wear the proper kind of shoes, to safeguard their feet. Providing goggles for the grinders to protect their eyes.

(6) Prompt action in cases of gross carelessness, disobedience, and taking chances by employes.

Results of Smoking.

In the discussion that followed the reading of the paper, it was the opinion of the various speakers, that smoking during working hours resulted in a far greater number of accidents than indulgence in alcoholic liquors, or through the carelessness or ignorance of the workmen. On the motion of Major Jos. T. Speer, Pittsburg, the thanks of the association were tendered Mr. West's committee for the investigation it had carried on, and the committee was dismissed. Mr. West stated, however, that the work would be continued under his direction.

The report of the committee on "Industrial Education" was read by P. Kreuzpointner, Altoona, Pa. It very ably reviewed social and industrial conditions, and suggested a system of industrial schools, serving general industrial purposes up to 16 years of age, and then becoming specified trade schools. These schools are to be supported by both the state and the community, making attendance compulsory up to 15 years of age, and the

employer recognizing the increased intelligence by a better wage which will induce parents to send their children to school instead of to the factory. The committee urged that the A. F. A. cooperate with the American Society for the Promotion of Industrial Education in the work which the latter is doing.

Before adjournment, J. S. Seaman, of Pittsburg, was appointed chairman of the committee on nominations.

Wednesday Morning.

At this session Acting-Chairman Webster announced the names of the committee, suggested by Secretary W. M. Corse, the previous day, to co-operate with representatives of the American Chemical Society and the United States Bureau of Standards in the compilation of standard methods of analysis for brass and kindred alloys. They are W. M. Corse, who also represents the American Chemical Society, E. S. Sperry, Bridgeport, Conn., and A. D. Little, chemist, Boston. Dr. W. F. Hillebrand is the government representative.

The paper entitled "The Manufacture of Brass Ingots, their Uses and Advantages," by W. M. Corse, Detroit, was read by the author. It dwelt on the efforts being made to improve this product. In some instances only skimmings, grindings and borings are used; but a mixture that has given good results has been developed consisting of red brass borings and copper, together with any white metals that may be necessary to bring the mixture to a definite composition. Brass ingots made from the average borings alone are often unsuited for good castings, because of the oxidation of the metal during melting and to the excess of impurities genrally present. To overcome this, a certain percentage of new metal, either in the form of ingot, wire or clippings was suggested.

E. S. Sperry, Bridgeport, Conn., asked how low it was possible to have iron in a brass ingot, and was informed by the author that in a yellow brass ingot it depended largely on the class of materials used. If yellow brass borings were used, the iron content would run from ½ to ¾ of 1 per cent; but if clips were used, there would be no more iron than in the original alloy because there would be no adhesion of the iron as in the case of borings.

Waste Heat.

The paper on "Waste Heat," by F. W. Reidenbach, manager, Genesee Metal Co., Rochester, N. Y., was next taken up. The author had no suggestions to make, confining himself to calling attention to the great losses resulting from the failure to secure full value from the combustible materials used in melting various metals. The company with which he is connected, he said, maintains a steam heating plant which heats the offices with the waste heat of two No. 22 crucible furnaces at an annual saving of $300 in fuel.

In the discussion that followed, Mr. Reidenbach was asked if the fumes from the brass did not affect the piping, to which he replied that the tubes acquired a coating which served to insulate the metal from the gases.

Another speeaker asked if it would not be more economical to use the waste heat from brass furnaces in pre-heating the gases in regenerative furnaces, and was answered that a gas producer would be required in this event and this would be too expensive.

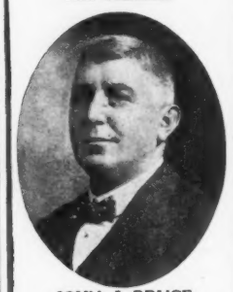
Mr. Corse told of the experience of the General Electric Co. in utilizing the waste heat from seven Schwartz furnaces. A large fan and heating coils were installed to provide heat for other buildings, but the plant has been taken out. The power consumed in operating the fan did not pay for the trouble, but the principal objection was that when the furnaces were not in operation there was no heat. This necessitated an auxiliary plant, and it proved to be as cheap to operate the auxiliary plant all the time rather than part of the time.

"The Patent Situation in the United States Respecting Alloys," by C. H. Clamer, Philadelphia, was read by Dr. Stevenson in the absence of the author. It was devoted principally to a review of a suit for infringement of a copper-tin-lead alloy patent brought by the Ajax Metal Co. against the Brady Brass Co. The court held that the case presented merely a change of proportions of the copper-tin-lead alloy of one degree. A patent has been reissued on the process of making the alloy which has the effect of an entirely new patent.

Side Blow Converter.

"The Side Blow Converter for Steel Castings, and Its Operation," by J. S. Whitehouse, of the Bonney-Floyd Co., Columbus, was the next paper considered. After reviewing the failures resulting from ignorance in operation, Mr. Whitehouse said

JOHN HILL
Chairman
Hall Committee



JOHN J. BRUCE
Hall Committee

JUSTUS THORNER
Hall Committee

F. W. WEISSMAN
Hall Committee

HERBERT BLACK
Hall Committee

that with proper blowing the main loss comes from the silicon in the charge, usually 2 per cent, which is oxidized along with the iron and manganese to form the slag. Another advantage is the increase in the amount of scrap which can be carried, and which helps to cut down the cupola loss by increasing the carbon in the charge.

In answer to a question of why he used so much scrap, Mr. Whitehouse said it was done to avoid getting the steel too hot as a very hot steel had a tendency to burn in the sand and make castings more difficult to clean.

Another question asked was whether he had any difficulty in pouring a whole heat in bull ladles when using 1.25 per cent silicon in the converter charge. His reply was that at the present time, it is not practicable to use small hand ladles, but he frequently poured whole heats in 125-pound ladles using four molders to pour off without skulling the ladles. He is also pouring heats into castings weighing under 30 pounds from a 1,000-pound ladle.

Dr. Moldenke told of attending the meeting of the American Electro-Chemical Society at Niagara Falls, and of the facilities for making steel direct from the ore in electric furnaces, the heat being generated by water power at long distances from the consuming source. He said that this method was not what they wanted. What they do want to know is how electricity could be applied to the production of steel castings in a plant auxiliary to an iron foundry. At present it is too expensive, but it makes fine castings.

T. J. Best, Montreal, asked for information on the cost of a small furnace for making steel in charges from 500 to 1,000 pounds. Dr. Moldenke replied that steel castings had been made from ore at a cost of about 5 cents per pound. Another member said that he had successfully operated a furnace producing castings as small as 20 to a pound. It was necessary to have a liberal tonnage of heavy castings, however, to take care of the surplus metal. No one could furnish any information on the main point of Mr. Best's question, other than that it was thought the electric steel melter was the cheapest. The paper entitled "Notes on Air Furnace Construction for Malleable Castings," by W. H. Kane, was read by title, as well as a paper on the "Use of Pulverized Coal for Foundry Purposes," by Richard K. Meade. The question was asked, after this paper was open for discussion, if coal had been used in cupolas, to which Dr. Moldenke replied not to his knowledge, although oil had been used in this connection in Germany, which to get quick composition in a high temperature showed great possibilities.

GEO. W. PIEHL
President
Cincinnati A. F. F.

JOHN LOGAN
Retiring President
Cincinnati A. F. F.

C. H. MESEKE
Secretary
Cincinnati A. F. F.

W. G. McINTOSH
Treasurer
Cincinnati A. F. F.

W. H. VANZANT
Sergeant-At-Arms
Cincinnati A. F. F.

"Machine Molding vs. Hand Molding," by Geo. Muntz, West New Brighton, N. Y., was next read. The meeting adjourned without any discussion of this paper.

Wednesday Afternoon.

"The Cost of Steel Melting in Foundries," by Bradley Stoughton, illustrated with lantern slides, was first considered. This paper dwelt fully on the costs of the crucible, converter, open-hearth and electric processes, and proved one of the most interesting of the meeting. One of the questions asked the author was if it would be possible to melt in the cupola and transfer the metal to the electric furnace for refining. The answer to this was that it could be done in the large sizes of electric furnaces, though these cost a very large amount. The cost sheets thrown on the curtain by Mr. Stoughton indicated that the electric furnace is not so cheap as the open-hearth or Bessemer processes, but is cheaper than the crucible process, provided electricity can be obtained at a moderate price. In answer to a question as to what was included in operating costs, he said that they included overhead charges, insurance, interest on investment and depreciation.

No discussion followed the reading of a paper entitled "The Heart of the Foundry as Seen by the Foundry Engineer," by D. S. Hawkins.

Continuous Melting.

S. D. Sleeth, Pittsburg, followed with his paper entitled "Continuous Melting in the Foundry of the Westinghouse Air Brake Co." While this system has been fully described in THE FOUNDRY, nevertheless, the paper proved one of the most interesting of the convention. Every detail regarding the system of sand conveying; the construction, speed and operation of the pouring table; the placing of cores, the number of men employed was eagerly sought for. Mr. Mueller, Decatur, Ill., told of a system of sand conveying he had used in his brass foundry. It worked all right for a short time, but the sys-

tem became too expensive because the sand cut the bearings and wore out the machinery too quickly and it was abandoned. One of the favorable features of the system of sand conveying brought out by Mr. Sleeth was that the flasks and sand shaken out of a mold are back again and being used within 20 minues. Another asked if it would be economical to install the Westinghouse system of continuous melting in a plant melting about 20 tons a day, to which Mr. Sleeth replied that at least 50 tons a day was required. Another questioner wanted to know if there was any jarring on the platform that might disturb the mold, and was told that this was so slight that it had no effect whatever. The table, it was explained, moves 21 feet a minute. Another question asked was if both sets of tuyeres were open at once, and the answer to this was that usually only the lower tuyeres. Another asked what kind of a drop was obtained when the bottom was dropped at the end of a day's continuous run, and was told just about the same as is obtained from a cupola running three of four hours. Good charging would overcome any bad effects in this direction. Another delegate wanted to know if Mr. Sleeth could give his actual loss of iron in the cupola and of iron accounted for, stating that 5 to 10 per cent was frequently lost in this manner. Mr. Sleeth said his loss averaged between 3 and 4 per cent, that they did not clean their sprues, and their gates were dumped into the cupola, dirt, sand and all. The brass foundrymen then took charge of the meeting after Mr. Sleeth finished.

Pyrometers.

The first paper was entitled "General Principles of Operation of Industrial Pyrometers," by C. H. Wilson. The main feature of this address was that "The application of a thermo-electric pyrometer for the determination of the temperature of brass prior to pouring, so far is only partially successful. The difference lies in the fact that there is not yet available a tube that will protect the thermo-couple from the molten metal, which it is necessary to do for any accurate results. There are protection tubes that would accomplish the result in the case of crucibles when it is sufficient to take the temperature after the crucible has been lifted to the floor; but there is nothing that will stand continuously in the process whether in crucible work or in the larger furnaces like the Schwartz. For experimental work, or where temperature readings are considered of importance, I would suggest only one method which has given satisfaction with both brass and gold.

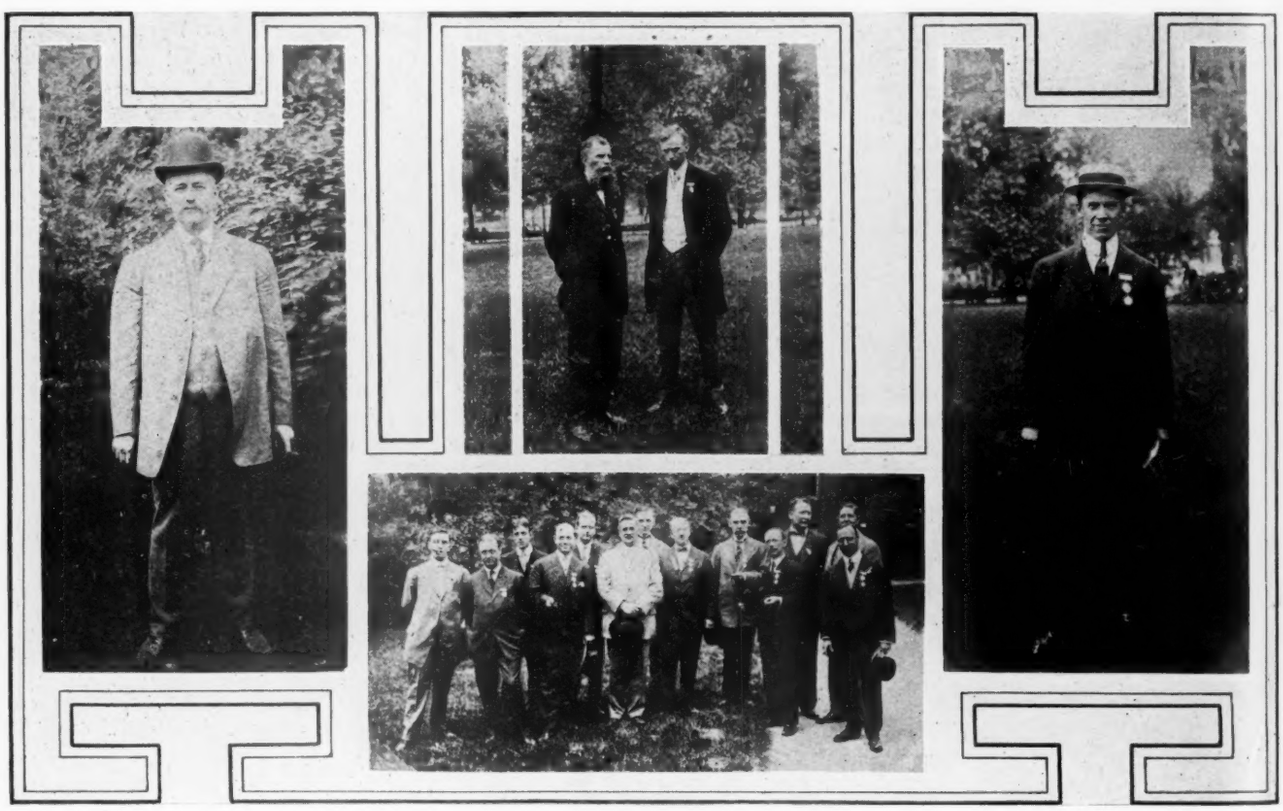
"A platinum, platinum-rhodium thermo-couple may be placed in a pyrometer tube and fused quartz, which material has practically a zero temperature coefficient and consequently will not crack from the constant extreme temperature change which occurs when the tube is put down into the brass."

"Notes on Brass Melting," by Charles T. Bragg, was read by title. Members, however, were invited to send in their discussion, which would be printed in the Transactions of the meeting.

Melting Brass Turnings.

"The Melting of Brass Turnings in the Oil Furnace," by Edward H. McVeen, of the F. W. Wakefield Brass Co., was next presented.

The discussion on this centered around the consumption of oil and air pressure in the various furnaces on the market.



F. N. PERKINS OUT FOR A STROLL IN THE PARK

DR. RICHARD MOLDENKE AND L. L. ANTHES SOUGHT A QUIET NOOK TO DISCUSS ASSOCIATION MATTERS

C. E. HOYT SETS THE FASHION FOR STRAW HATS

EXECUTIVE HEADS OF SOME OF THE LEADING FOUNDRY SUPPLY AND EQUIPMENT MANUFACTURING CONCERNS

Two or three members corroborated Mr. McVeen's statement of the improved castings resulting from using remelted metal, one stating that he always followed this practice on government and high pressure work.

In reply to a question, the speaker stated that he used four pounds instead of four ounces air pressure at the start, and at the end of the heat, about seven pounds. The difference in the pressure depended on the type of furnace used. Mr. Parry stated that he used 45 pounds oil pressure and 14 to 16 pounds air pressure. He further stated that in their tests they used an impeller type of blower, also a fan blower; finally got the best results by using 45 pounds oil pressure, with 14 to 16 pounds air.

Election of Officers.

After passing a vote of thanks and extending condolences to the retiring president, Charles J. Caley, who was unable to attend the convention owing to sickness, the members of the American Brass Founders' Association elected the following officers:

President, William R. Webster, Bridgeport Brass Co., Bridgeport, Conn.
Vice president, rolling mill department, E. O. Goss, Scovill Mfg. Co., Waterbury, Conn.
Vice presidents, brass foundry, plating and polishing departments—A. H. Warner, Stebbings Mfg. Co., Springfield, Mass.; W. L. Abate, Nathan Mfg. Co., New York City; Thomas Evans, Eynon & Evans Mfg. Co., Philadelphia; L. W. Olsen, Ohio Brass Co., Mansfield, O.; J. N. Gamble, National Tube Co., Kewanee, Ill.; W. D. Allen, Allen Mfg. Co., Chicago; J. Cessna Sharp, John C. Sharp Brass Works, Chattanooga, Tenn.; N. K. B. Patch, Lumen Bearing Co., Toronto, Can.; Richard R. Mitchell, R. E. Mitchell Co., Montreal, Que.
Secretary and treasurer, W. M. Corse, Michigan Smelting & Refining Co., Detroit.

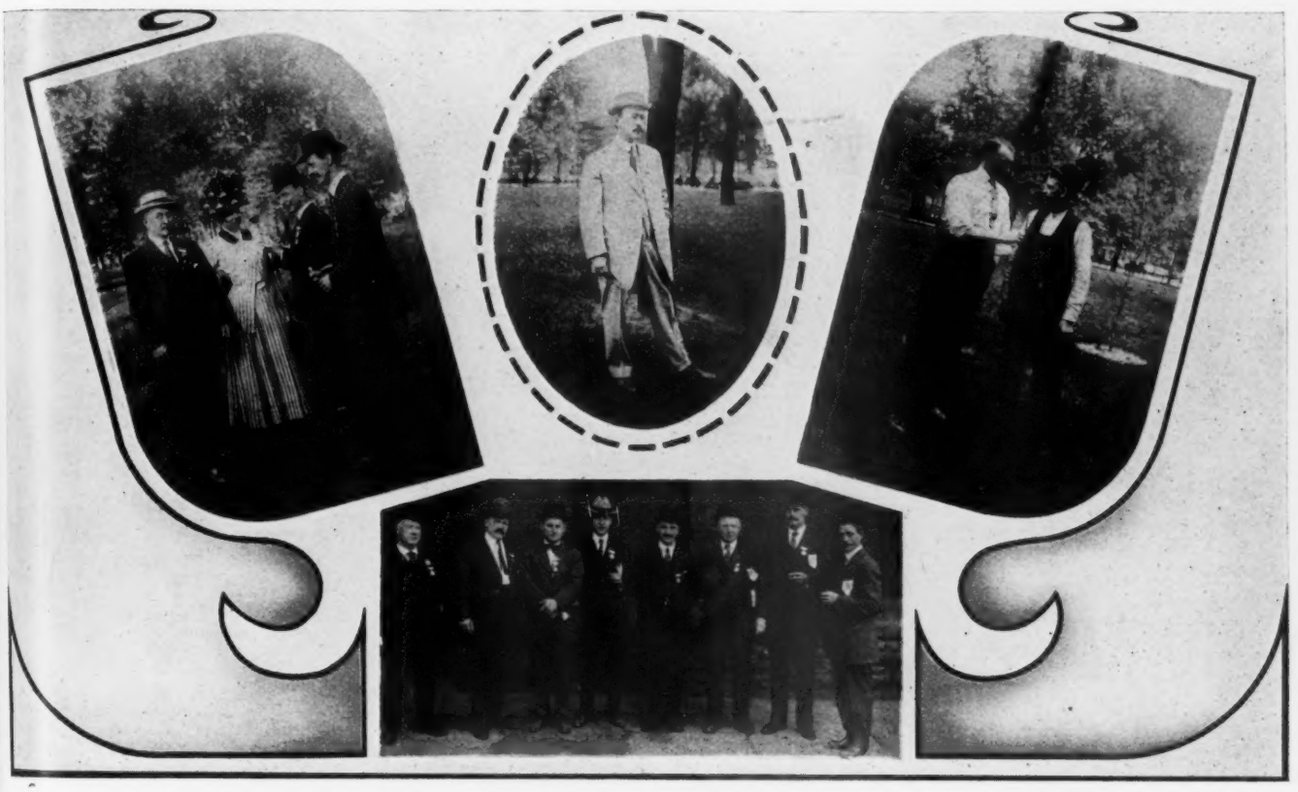
Associated Foundry Foremen.

The business session of the Associated Foundry Foremen was held at the Grand Hotel on Wednesday evening. The report of C. E. Hoyt, secretary-treasurer, showed a net balance in the treasury amounting to $294.08. Mr. Hoyt was reluctant to accept the secretaryship for another year, because of the large amount of labor involved, the unsatisfactory co-operation of the members, and because of the confusion existing, growing out of the failure of the constitution and by-laws to provide for the changed conditions that had arisen since the organization was founded. After considerable discussion, it was finally decided to appoint a committee of five, composed of Messrs. Everitt, Perrine, Marshall, Becker and Kettelson to draw up a new constitution and by-laws. This will be submitted to the association for adoption by a letter ballot vote. Inasmuch as it is intended to entrust greater powers to the secretary, Mr. Hoyt consented to the proposal of his name as secretary and treasurer, and he was renominated with loud approval.

Officers for the ensuing year were elected as follows:

President, Eugene W. Smith, Crane Co., Chicago.
First vice president, W. F. Grunau, Erie City Iron Works, Erie, Pa.
Second vice president, J. L. Marshall, Geo. H. Smith Steel Casting Co., Milwaukee.
Secretary and treasurer, C. E. Hoyt, Lewis Institute, Chicago.

The smoker at the Grand Hotel on Monday evening, under the auspices of the Cincinnati section of the Associated Foundry Foremen, to which all foremen were invited, was largely attended.



HOWARD M. BOUGHER AND PARTY ENJOYING SOME OF THE NATURAL SCENERY OF THE QUEEN CITY

C. B. SPAULDING AND HIS SOUVENIRS WERE VERY POPULAR

E. KILLING DISCUSSES MOLDING MACHINES WITH ONE OF HIS ASSOCIATES

J. S. SMITH IN THE HANDS OF A FEW OF HIS FRIENDS IN THE FOUNDRY TRADE

Thursday Morning.

"The Electrolytic Assay of Copper" was the first paper on the program Thursday morning and was read by title, owing to the absence of the author. "The Tensile Strength of Zinc-Aluminum Alloys" was next presented by W. D. Bancroft. In determining these tests, the author said special precautions were taken to secure metals as pure as possible. The aluminum was 99.9 per cent pure. The zinc used was Bertha pure zinc, which contained not over 0.2

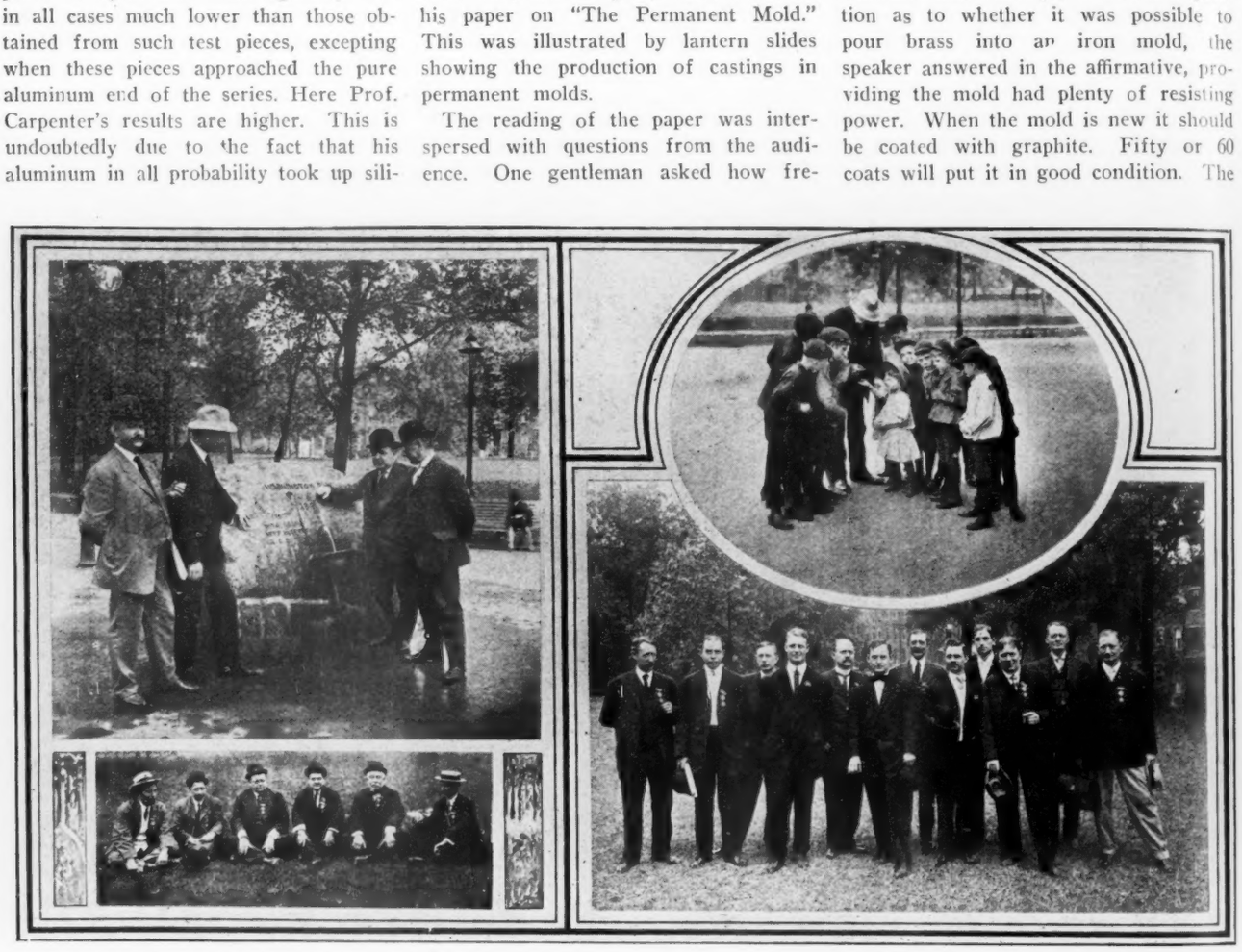
per cent impurities. Pure graphite crucibles were made from bars of artificial graphite. Mr. Bancroft summed up as follows: "In conclusion, it might be said that the alloys throughout the series, if chill cast and quickly quenched, thereby assuming small crystal size, possess strengths considerably greater than usually obtained. The values given by Prof. Carpenter (who made the only previous systematic investigation) are in all cases much lower than those obtained from such test pieces, excepting when these pieces approached the pure aluminum end of the series. Here Prof. Carpenter's results are higher. This is undoubtedly due to the fact that his aluminum in all probability took up silica from the crucible and was no longer pure material. Most of our alloys show strengths running from 25,000 to 35,000 pounds per square inch, while Prof. Carpenter obtained 25,000 as a maximum value. With pure zinc, strengths of about 9,000 pounds are obtained. In melting the metals, the temperature should never go above 700 degrees Cent., as above this limit the aluminum takes up carbon quite appreciably. The experimental part of the work has been done chiefly by W. B. White, and is now being finished by V. Skillman. G. B. Upton, of Sibley College, assisted in the tests. The expense of the investigation was defrayed by a grant from the Carnegie Institute."

The paper entitled, "System of Distributing Waste Losses in Raw Materials to the Cost of the Finished Product," was summarized by the author, D. W. Olson.

Permanent Molds.

Edgar A. Custer, of the Tacony Iron Co., Philadelphia, followed with his paper on "The Permanent Mold." This was illustrated by lantern slides showing the production of castings in permanent molds.

The reading of the paper was interspersed with questions from the audience. One gentleman asked how freing had to remain in the mold before it was ready to shake out, to which Mr. Custer replied that in the case of a 2-inch pipe, three to six seconds, and with a 6-inch pipe, the time ranges from five to 15 seconds. Replying to another question, the speaker stated that the heaviest casting made in the permanent mold was 110 pounds. Greater allowances have to be made for gates than in sand. In reply to another question as to whether it was possible to pour brass into an iron mold, the speaker answered in the affirmative, providing the mold had plenty of resisting power. When the mold is new it should be coated with graphite. Fifty or 60 coats will put it in good condition. The quently a mold was poured, and Mr. Custer replied one in 40 or 50 seconds, comfortably. They tried to keep the mold cool, artificially. In the case of a mold weighing 1,700 pounds, and the casting weighing 42 pounds, a mold was poured every seven minutes. In answer to another question, the speaker stated they had cast over 6,000 pieces in a single mold, and the same was in better condition than when first used. Another member asked how to prevent moisture accumulating in the mold, and he was told that it was necessary to wipe each mold carefully before pouring. Another question asked was how long the castpaper on "Continuous Melting," prepared by Richard H. Probert, Louisville, Ky., was read by title.



F. N. Perkins, E. W. Smith and S. T. Johnston Made Frequent Pilgrimages to Moses' Rock

Eugene W. Smith Distributing Pennies in the Park

The Pridmore Molding Machine Sextet

The Cleveland Delegation

Friday Morning.

Probably the most important work accomplished during the convention was the adoption of standard specifications for foundry pig iron. These were submitted by the committee appointed at the Toronto convention last year, and represented the joint efforts of the A. F. A. committee, and committees from the American Society for Testing Materials, the Philadelphia Foundrymen's Association, and the Eastern Pig Iron

Association. H. E. Field, Pittsburg; Henry A. Carpenter, Providence, and Stanley G. Flagg Jr., Philadelphia, comprised the A. F. A. representation. The report was not adopted without some sharp criticism from furnace and commercial laboratory interests, but it finally prevailed and was adopted without change.

Eliot A. Keber, manager of sales, Matthew Addy & Co., Cincinnati, opposed the adoption of the report without a more thorough discussion. He stated that the adoption of the gravimetric method for sulphur determinations was a most serious change from the usual practice, as practically all the furnaces and many of the commercial chemists determine their sulphur volumetrically and the latter is used by a majority of the foundries in making their mixtures.

Discussion of Pig Iron Specifications.

"The absurdity of the gravimetric method," he said, "is seen when, for instance, a furnace ships a customer an iron running 0.045 per cent sulphur, volumetrically, and the customer rejects the same because his chemist might find 0.55 per cent sulphur by the gravimetric method in the same iron. The gravimetric method should not be adopted as a standard until the foundrymen are willing to receive an apparently higher sulphur on their contract if this method is used. In addition, it has not as yet been proven that an iron which shows volumetrically, sulphur 0.045 per cent, and gravimetrically 0.055 per cent, is a poorer iron than one which shows 0.045 per cent by both methods. In proposing a specification it should be borne in mind that pig iron is made by charging large quantities of ore, limestone and coke of varying analyses in the top of a furnace, and this is not seen until it runs from the bottom as molten pig iron, and even with the best skill that can be purchased there will still be a great variation in the product, and if specifications are drawn so closely that only a small portion is considered standard, this must be sold at a relatively high price to offset the lower price at which the balance must be sold, because under the proposed gravimetric specifications this balance might be penalized on account of high sulphur shown. Under the percentage and variation table an allowance in silicon is permitted of 0.25 either way. If this table were adopted as shown, and a customer ordered 2 per cent silicon and a car of iron analyzing exactly 2 per cent is shipped on the order, the customer might pay for this as under contract price or at the price of 2.25 per cent silicon, or at the price of 1.75 per cent silicon, as this determination would come in the first instance exactly on the standard and in the last two cases within the allowed variation of the other two grades. This same suggestion applies to the manganese, where the allowance is exactly the same as the difference between the different grades. As carbons are very rarely determined, it would be well to omit 'Total Carbon' from the specifications."

E. J. Stoddard, Detroit Testing Laboratory, Detroit, said it was unnecessary to split hairs in the average foundry over 0.005 in the sulphur, and inasmuch as nearly all commercial laboratories use the evolution method, he disapproved the idea of specifying any method. Furthermore, the foundryman would not pay for a gravimetric determination.

Dr. Moldenke replied that merely because a method is in general use is no reason why the association should sanction its continuance when it knew the same is wrong. He said there should be two prices for the volumetric and gravimetric, to which Mr. Stoddard answered that it was hard enough to collect for the present relatively cheap system.

H. E. Field, Pittsburg, chairman of the committee proposing the specifications, in answer to the objections raised to the report, said: "The committee recognized the fact that a slight extra expense would be caused the furnaces in adopting the gravimetric method and gave this due consideration, but considered that this extra expense was absolutely necessary. Every iron differs in the proportion of sulphur that is evolved. This difference is practically constant in each brand of iron, and it would be very little trouble for the furnace to fix its

THE PITTSBURG "ROOTERS" CAME WELL PREPARED TO LAND THE 1910 CONVENTION

own differential and sell on the gravimetric basis. It could analyze its iron volumetrically and have a gravimetric method by its own chemist or by some reputable chemist once in a while. The specifications submitted took this into account and made the gravimetric method optional with the signers of the contract. Should the founder be assured that the iron he was buying gave all the sulphur by the evolution method, he could accept the evolution method in the contract. This question is so important that the committee gave months of consideration to it and came to the conclusion that the only way of making the specifications in any way suitable and lasting was to adopt the gravimetric method. In regard to the question of variation in silicon mentioned by Mr. Kebler, the questions in the final report will take care of these."

Major Speer, of Pittsburg, believed the report ought to be adopted and if the commercial chemists could not make a gravimetric analysis, they should be educated to do so. The following standard foundry pig iron specifications were then adopted:

Proposed Standard Specifications for Buying Foundry Pig Iron.

It is recommended that foundry pig iron be bought by analysis, and that when so bought these standard specifications be used.

PERCENTAGES AND VARIATIONS.

In order that there may be uniformity in quotations, the following percentages and variations shall be used.

(These specifications do not advise that all five elements be specified in all contracts for pig iron, but do recommend that when these elements are specified that the following percentages be used.)

SILICON.

(0.25 allowed either way)

	(Code)
1.00	(La)
1.50	(Le)
2.00	(Li)
2.50	(Lo)
3.00	(Lu)

SULPHUR.

(Maximum)

	(Code)
0.04	(Sa)
0.05	(Se)
0.06	(Si)
0.07	(So)
0.08	(Su)
0.09	(Sy)
0.10	(Sh)

TOTAL CARBON.

(Minimum)

	(Code)
3.00	(Ca)
3.20	(Ce)
3.40	(Ci)
3.60	(Co)
3.80	(Cu)

MANGANESE.

(0.20 either way)

	(Code)
0.20	(Ma)
0.40	(Me)
0.60	(Mi)
0.80	(Mo)
1.00	(Mu)
1.25	(My)
1.50	(Mh)

PHOSPHORUS.

	(Code)
0.20	(Pa)
0.40	(Pe)
0.60	(Pi)
0.80	(Po)
1.00	(Pu)
1.25	(Py)
1.50	(Ph)

Percentages of any element specified one-half way between the above shall be designated by addition of letter to next lower symbol.

In case of phosphorus and manganese, the percentages may be used as maximum or minimum figures, but unless so specified they will be considered to include the variation above given.

A FEW OF THE MANY SOUVENIRS DISTRIBUTED

SAMPLING AND ANALYSIS.

Each car load, or its equivalent, shall be considered as a unit in sampling.

One pig of machine-cast, or one-half pig of sand cast iron shall be taken to every four tons in the car, and shall be so chosen from different parts of the car as to represent as nearly as possible the average quality of the iron.

Drillings shall be taken so as to fairly represent the composition of the pig as cast.

An equal weight of the drillings from each pig shall be thoroughly mixed to make up the sample for analysis.

In case of dispute, the sample and analysis shall be made by an independent chemist, mutually agreed upon, if practicable at the time the contract is made.

It is recommended that the standard methods

of the American Foundrymen's Association be used for analysis. Gravimetric methods shall be used for sulphur analysis, unless otherwise specified in the contract.

The cost of resampling and reanalysis shall be borne by the party in error.

BASE OR QUOTING PRICE.

For market quotations an iron of 2.00 per cent in silicon (with variation of 0.25 either way), and sulphur 0.05 (maximum), shall be taken as the BASE.

Sulphur, Per Cent	Silicon Per Cent 3.25	3.00	2.75	2.50	2.25	2.00	1.75	1.50	1.25	1.00
0.04	B+6C	B+5C	B+4C	B+3C	B+2C	B+1C	B	B—1C	B—2C	B—3C
0.05	B+5C	B+4C	B+3C	B+2C	B+1C	B	B—1C	B—2C	B—3C	B—4C
0.06	B+4C	B+3C	B+2C	B+1C	B	B—1C	B—2C	B—3C	B—4C	B—5C
0.07	B+3C	B+2C	B+1C	B	B—1C	B—2C	B—3C	B—4C	B—5C	B—6C
0.08	B+2C	B+1C	B	B—1C	B—2C	B—3C	B—4C	B—5C	B—6C	B—7C
0.09	B+1C	B	B—1C	B—2C	B—3C	B—4C	B—5C	B—6C	B—7C	B—8C
0.10	B	B—1C	B—2C	B—3C	B—4C	B—5C	B—6C	B—7C	B—8C	B—9C

PENALTIES.

In case the iron, when delivered, does not conform to the specifications, the buyer shall have the option of either refusing the iron, or accepting it on the basis shown in the above table, which must be filled out at the time the contract is made.

ALLOWANCES.

In case the furnace cannot for any good reason deliver the iron as specified at the time delivery is due, the purchaser may at his option accept any other analysis which the furnace can deliver, the price to be determined by the base table above, which must be filled out at the time the contract is made.

BASE TABLE.

The accompanying table may be filed out may become a part of the contract: "B," or Base, represents the price agreed upon for a pig iron running 2.00 in silicon (with allowed variation of 0.25 either way) and under 0.05 sulphur. "C" is a constant differential to be determined at the time the contract is made.

(This table is for settling any differences which may arise in filling a contract, as explained under penalties and allowances, and may be used to regulate the price of a grade of pig iron which the purchaser desires, and seller agrees to substitute for the one originally specified.)

Silicon percentages allow 0.25 variation either way. Sulphur percentages are maximum.

Election of Officers.

Officers for the ensuing year were elected as follows:

President, Arthur T. Waterfall, Russel Wheel & Foundry Co., Detroit.

Vice presidents—First district, F. B. Farnsworth, McLagon Foundry Co., New Haven, Conn.; second district, Walter Wood, R. D. Wood & Co., Philadelphia, Pa.; third district, Joseph T. Speer, Pittsburg Valve Foundry & Construction Co., Pittsburg; fourth district, Eugene W. Smith, Crane Co., Chicago; fifth district, Thos. W. Sheriffs, Sheriffs Mfg. Co., Milwaukee, Wis.; sixth district, Alf. E. Howell, Phillips & Buttorf Mfg. Co., Nashville, Tenn.; seventh district, William Gilbert, Buckeye Foundry Co., Cincinnati, O.; eighth district, A. F. N. Clare, Clare Stove Co., Preston, Ont.

Secretary and treasurer, Dr. Richard Moldenke, Watchung, N. J.

Steel Founders' Association.

Before the close of the session, announcement was made by the secretary that he had been approached by several steel founders with the suggestion that an association, educational in scope, be organized, along the lines of the other affiliated bodies. No action was taken, however, other than that the request was referred to the executive committee, several protests to the suggestion having been made because of the existence of an organization with similar aims in view.

The resolution was unanimously adopted that another ballot be taken during the year on the question of increasing the dues in the A. F. A. from $5 to $10, and that if two-thirds of those voting are in the affirmative, the increase is to be adopted.

A motion was adopted that John Jermain Porter, University of Cincinnati, who read a paper on "The Practical Value of Chemical Standards for Iron Castings," should be appointed chairman of a committee, with power to select his own associates, for the purpose of "classifying castings according to the physical properties which are of importance in them, and then to tabulate the chemical compositions which are found suitable for each class." Dr. Porter made this suggestion in the closing paragraphs of his paper, adding that "it would also be highly desirable to take some cognizance of the factor of the cost of the mixture and show, where possible, how the foundryman could cut down the cost of his iron without decreasing the quality of his product."

As is customary, L. L. Anthes, of Toronto, the retiring president, was made an honorary member of the association. A vote of thanks was also extended the local entertainment committee, authors of papers and retiring officers.

Invitations were read by Dr. Frank T. F. Stephenson, inviting the association to meet in Detroit in 1910, and by Joseph T. Speer, Pittsburg, inviting the association to that city in 1911. Both were referred to the executive committee for action.

ARTHUR T. WATERFALL

Arthur T. Waterfall, who was elected president of the American Foundrymen's Association at the Cincinnati convention, is superintendent of the large plant of the Russel Wheel & Foundry Co., Detroit. This concern is engaged in an engineering business of considerable magnitude, the foundry department making a specialty of large castings for jobbing work, in addition to producing a complete line of car castings and brake-shoes.

Identified with this concern for more than 20 years, the American Foundrymen's Association has a chief executive of wide practical foundry experience. Of English parentage, Mr. Waterfall was born in Detroit in 1870. He received a common school education supplemented with such technical information as could be absorbed by the aid of night school and private tuition. During the past four years he has been general superintendent of the plant of the Russel Wheel & Foundry Co., having served an apprenticeship in the foundry and pattern departments of this concern, followed by several years in the office in a confidential clerical capacity. For many years he has taken an active part in the work of the American Foundrymen's Association, and has been treasurer of the Detroit Foundrymen's Association since its organization.

ARRANGEMENTS FOR THE BRITISH FOUNDRYMEN'S CONVENTION.

Preparations for the convention of the British Foundrymen's Association, to be held in Birmingham this year, are well advanced. The association practically had its origin in Birmingham, but this is the first meeting to be held in the city. The previous conventions, commencing in 1906 were held at Glasgow, Sheffield, and Newcastle-on-Tyne. Each has been more successful than its predecessor, and it is anticipated that the Birmingham convention will be still more important as the district is one of the strongest in membership. The papers arranged for so far are the following:

"Twenty-five Years of Cast Iron," Prof. T. Turner.

"Influence of Chemical Compounds on the Properties of Cast Iron," A. H. Hiorns, principal of the metallurgical section, Birmingham technical school.

"The Production of Patterns for Light Castings," W. H. Sherburn, Warrington.

"The Application of Rule-of-Thumb and Science in the Foundry," Sidney G. Smith, Chesterfield.

"The Cupola," H. Pemberton, Derby.

Visits to works will be arranged as far as possible, but owing to the extent to which the August Bank Holiday is observed in the district, it is possible that some of the foundries and other interesting establishments which the members would like to visit may not be available for inspection. In that case, visits to some of the blast furnaces and rolling mills in the Black country will fill up the program. Birmingham is exceedingly hospitable on occasions of this kind and no doubt the social features of the visit will be exceptionally enjoyable.

COST OF STEEL MAKING IN FOUNDRIES*

Treated from the standpoint of the future relation of electric steel making processes to present methods in foundry work

BY BRADLEY STOUGHTON

THE object of this study is not particularly to publish the cost of making steel for castings but rather to consider this subject from the standpoint of the future relation of electric steel making processes to the present steel making methods in foundry work. The electric process has already established itself in steel works for making ingots, especially in Europe where it is now a real factor in the industry. In America there are already some electric steel making furnaces in operation and several others in the process of installation, although none of these, so far as we are informed, will enter the steel casting field. Notwithstanding that there are indications of a lively interest in this type of furnace on the part of the steel casting industry. In introducing these figures, I would say that I have no connection with electric furnaces in any way and do not expect to have, the object in making the study being merely one of interest.

Acid Open-Hearth.

The cost of steel making by the acid open-hearth process is shown in Table I. In connection with this and the other tables it is to be observed that the price of raw materials is figured on the basis of a short ton, and all prices in this paper are based on the current price of the materials in Pittsburg, the first week of May, 1909.

It is not to be supposed that these figures will be accepted by everyone as representative of their practice or anything like it, but the prices and weights of raw materials can be changed by anyone to conform with his practice. The item of heads, gates, etc., will depend largely upon the class of work made. No doubt there are some foundries in which the percentage of heads, gates, skulls, scrap, etc., is less than 33, while in others it will be above that figure. One has only to consider the difference in this respect between a foundry making steel rolls and one doing electrical work, notably castings for motors, to appreciate how great a difference will exist. I have adopted here 33 per cent of scrap in the cases of all processes, to make this item comparative.

Defective Castings.

The item, defective castings, chargeable against the furnace, as distinguished from those chargeable against bad molding will also vary greatly in different places, and it is probably impossible to estimate an average figure either for the percentage of these made or for the price. The latter will depend partly on the average selling price of the castings, and partly on the condition of the castings when the defects were discovered, as for example, whether costs of cutting-off heads and gates, cleaning, shipping to and from the customer, etc., should be included. In point of fact it is probable that there are not many foundries in which the defective castings chargeable against bad metal are differentiated from those chargeable against bad molding, yet it is evident that the former only should be included in the cost of steel. Defective castings chargeable against molding are included in the item of heads, gates, etc.

The charge of $5.50 for operating costs per ton is practiced with a 25-ton furnace operating at maximum capacity, charging raw materials by hand. For small furnaces and furnaces operating at low capacity this item will be materially larger. It is not to be supposed that the $5.50 is a minimum figure as no doubt some practice is better than this, and $8.85 is not a maximum figure as the cost of some furnaces is somewhat higher.

Basic Open-Hearth.

The cost of making steel for castings by the basic open-hearth process is shown in Table II, and the same

Table I.

Cost of acid open-hearth steel.

Raw materials.	Price of raw materials, per 2,000 pounds.	Per 2,000 pounds of steel in ladle. Weight used, pounds.	Per cent used.	Cost.	Cost.
Pig iron	$14.00	300	15	$2.10	
Heads, gates, etc.	14.00	660	33	4.62	
Foreign scrap	14.50	1080	54	7.83	
Defective cast'gs* from bad metal	50.00*	20	1	.50	
Ferro-alloys	40.60	29	1	.59	
Total metal		2089	104	$15.64	$15.64
Operating costs				5.50§	8.85§
Cost of steel in ladle				$21.14	$24.49
Cost of steel in castings.					
Cost of steel in ladle ÷ 65 per cent** =				$32.52	$37.68
Less credit for heads, etc., as scrap =				4.62	4.62
Net cost of steel in castings.				$27.90	$33.06

**Of the steel in the ladle, 65 per cent goes into castings, 33 per cent goes into heads, gates, etc., and 2 per cent is lost in spattering, etc.

*The price given for defective castings is over and above their value as scrap.

§The charge of $5.50 for operating costs is the figure for a 25-ton furnace and large tonnage; that of $8.85 is for a small furnace and small production.

*Presented at the Cincinnati convention of the American Foundrymen's Association.

Table II.

Cost of basic open-hearth steel.

Raw materials.	Price of raw materials, per 2,000 pounds.	Per 2,000 pounds of steel in ladle. Weight used, pounds.	Per cent used.	Cost.	Cost.
Pig iron	$12.75	1040	52	$6.63	
Heads, gates, etc.	14.00	660	33	4.62	
Foreign scrap	11.15	350	17½	1.95	
Defective castings*	50.00*	40	2	1.00	
Ferro-alloys	40.60	33	1½	.67	
Total metal		2123	106	$14.87	$14.87
Operating costs				6.10	9.55
Cost of steel in ladle				$20.97	$24.42
Cost of steel in castings.					
Cost of steel in ladle ÷ 65 per cent** =				$32.26	$37.57
Less credit for heads, etc., as scrap =				4.62	4.62
Net cost of steel in castings.				$27.64	$32.95

*See footnote under acid open-hearth table.

**Of the steel in the ladle, 65 per cent goes into castings, 33 per cent goes into heads, gates, etc., 2 per cent is lost in spattering in pouring.

§See footnote under acid open-hearth table.

comments made under the head of acid open-hearth steel will apply here.

The difference in costs between basic open-hearth and acid open-hearth shown here is less than the experience of several would lead them to believe. The explanation of this is that the basic open-hearth process is in use generally in districts where low phosphorus raw materials sell at a lower price as compared to high phosphorus raw materials than is the case in the Pittsburg district and also because the greater proportion of defective castings made in the basic process is not ordinarily included in figuring the cost of the steel. Furthermore, in the cost here given, the basic process is under a disadvantage through having to use 33 per cent of its own heads and gates which command a higher price in the market than scrap suitable for the basic process would demand. This condition explains the common practice of operating both a basic and acid furnace in the same plant, enabling the acid furnace to use the scrap from both processes at a favorable figure and thus allowing a larger proportion of cheaper basic scrap to be purchased outside. This condition is exemplified in Table III, where the benefit of the combination to both processes is shown.

Table III.

Cost of acid and basic open-hearth steel when together in one plant.

Raw materials.	Acid open-hearth. Per 2,000 pounds of steel in ladle. Price of raw materials per 2,000 pounds.	Weight used, pounds.	Per cent used.	Cost.	Basic open-hearth. Per 2,000 pounds of steel in ladle. Price of raw materials.	Weight used, pounds.	Per cent used.	Cost.
Pig iron	$14.00	300	15	$2.10	$12.75	1040	52	$6.63
Heads, gates, etc., from both furnaces	14.00	1320	66	9.24	.....	....	..	.....
Foreign scrap	14.50	420	21	3.05	11.15	1010	15½	5.63
Defective castings	50.00	20	1	.50	50.00	40	2	1.00
Ferro-alloys	40.60	29	1	.59	40.60	33	1½	.67
Total metal		2089	104	$15.48		2123	106	$13.93
Operating costs				5.50				6.10
Cost of steel in ladle				$20.98				$20.03
	Cost of steel in castings:				Cost of steel in castings:			
Cost of steel in ladle ÷ 65 per cent				$32.28	.....			$30.81
Less credit for heads, etc., as scrap				4.62	.....			4.62
Net cost of steel in castings				$27.66	.....			$26.19

Table IV.

Cost on converter steel.

Raw materials.	Per 2,000 pounds of steel in ladle. Price of raw materials, per 2,000 lbs.	Weight used, pounds.	Per cent used.	Cost.	Cost.
Pig iron	$14.00	300	15	$2.10	
Pig iron	17.40	1280	64	11.14	
Heads, gates, etc.	14.00	660	33	4.62	
Defective castings from bad metal*	80.00*	20	1†	.80†	
Ferro-alloys	40.60	35	2	.71	
Total metal		2295	115	$19.37	$19.37
Operating costs				3.50	5.50
Cost of steel in ladle				$22.87	$24.87
Cost of steel in castings.					
Cost of steel in ladle ÷ 65 per cent				$35.18	$38.26
Less credit for heads, etc., as scrap				4.62	4.62
Net cost of steel in castings.				$30.56	$33.64

*See footnote under acid open-hearth table.

†The per cent of defective castings in converter practice will actually be less than this, so that the cost is a little higher than justice to average converter practice demands. In the absence of average figures, we have charged it the same as acid open-hearth with this verbal correction.

§Operating costs, $3.50, is for one two-ton converter making 150 tons per week. The $5.50 per ton is a 2-ton converter with small production.

Table V.

Converter with large waste.

Raw materials.	Per 2,000 pounds of steel in ladle. Price of raw materials, per 2,000 pounds.	Weight used.	Per cent used.	Cost.	Cost.
Pig iron	$14.00	300	15	$2.10	
Pig iron	17.40	1360	68	11.83	
Heads, gates, etc.	14.00	660	33	4.62	
Defective castings from bad metal	80.00	40	1	.80	
Ferro-alloys	40.60	38	2	.77	
Total metal		2398	119	$20.12	$20.12
Operating costs				3.50	5.50
Cost of steel in ladle				$23.62	$25.62
Cost of steel in castings.					
Cost of steel in ladle ÷ 65 per cent				$36.34	$39.42
Less credit for heads, etc., as scrap				4.62	4.62
Net cost of steel in castings.				$31.72	$34.80

Converter.

The cost of steel-making by the converter process is shown in Table IV, where the same comments apply as those made in connection with the acid open-hearth process.

The operating cost of $3.50 per ton applies to the making of 150 tons of castings per week in one converter. It will appear too low to some practitioners who have to pay a high price for fuel, etc., and whose tonnage is lower. A second figure of $5.50 per ton is therefore shown to apply under such circumstances.

The waste of metal of only 15 per cent shown in the foregoing table, will also appear low to many whose practice is not as favorable as this and therefore Table V is given to illustrate the cost under such conditions.

Table VI.

Acid open-hearth, making small castings.

Raw materials.	Per 2,000 pounds of steel in ladle. Price of raw materials, per 2,000 pounds.	Weight used, pounds.	Per cent used.	Cost.	Cost.
Pig iron	$14.00	300	15	$2.10	
Heads, gates, etc.	14.00	660	33	4.62	
Foreign scrap	14.50	980	49	7.11	
Defective castings from bad metal	50.00	120	6	3.00	
Ferro-alloys	40.60	29	1	.59	
Total metal		2089	104	$17.42	$17.42
Operating costs				5.50	8.85§
Cost of steel in ladle				$22.92	$26.27
Cost of steel in castings.					
Cost of steel in ladle ÷ 65 per cent* =				$35.26	$40.41
Less credit for heads, etc., as scrap =				4.62	4.62
Net cost of steel in castings.				$30.64	$35.79

It will be observed that the converter is not in a position to compete on even terms with either the acid or basic open-hearth process and must rely on a special grade of work for its field. This field, as is well known, is the manufacture of steel for small castings where the small converter now holds the predominant position. Since the electric process will doubtless first enter this same field, it may be well to consider anew the acid and basic open-hearth processes from this standpoint.

Small Castings.

The most important circumstance which keeps the open-hearth processes largely out of the field of making

*Of the steel in the ladle, 65 per cent goes into castings, 33 per cent goes into heads, gates, etc., 2 per cent is lost in spattering during pouring. In making small castings the loss in pouring from a bottom-poured ladle will be much larger than this, and the cost of steel in castings would be increased $1 to $3 per ton, but data are lacking for exact estimates.

steel for small castings, and which often results in open-hearth foundries even sending their orders for small castings to foundries equipped wth a converter or crucible process, is the large percentage of defective castings made by the open-hearth process when producing steel for small castings, say for example, castings thin in section and under 100 pounds in weight. In Tables VI and VII I have shown the costs of steel in the acid and basic open-hearth processes where the percentage of defective castings chargeable to bad metal is large. It may be that some open-hearth foundries will deny the suggestion that the percentage of defective castings due to bad metal is ever so large as the figures given but we do not think that the practice from which these figures were taken was unusually bad. If a foundry is making 1,000 tons of heavy castings per month and 50 to 100 tons of castings under 100 pounds apiece, defective castings to the extent of even 25 per cent of all the small castings would not make a great show in the month's figures unless special means are taken to show separately the percentage of defective castings under and over 100 pounds weight.

Wherever the electric steel-making process has come into use it has been the crucible steel process that has usually been supplanted with one or two notable exceptions; therefore it is the crucible steel foundries that view the electric process with the most interest. One important consideration in this connection is, however, the cost of installation, for this will be at least ten times as much in the case of the electric process as in the case of the crucible process. The cost of making crucible steel is given in Table VIII, which is divided into two parts, the first illustrating the cost when melting wrought iron, which is common practice when making the higher grades of tool steel, etc., and the second when melting low phosphorus steel scrap. It is the latter type of practice which steel foundries usually employ and these figures will only be used for comparison.

Table VII.

Basic open-hearth making small castings.

Raw materials.	Price of raw materials, per 2,000 pounds.	Per 2,000 pounds of steel in ladle. Weight used, pounds.	Per cent used.	Cost.	Cost.	Weight used, pounds.	Per cent used.	Cost.	Cost.
Pig iron	$12.75	1040	52	$6.63		1040	52	$6.63	
Heads, gates, etc	14.00	660	33	4.62		660	33	4.62	
Foreign scrap	11.15	190	9½	1.06		91	4½	.51	
Defective castings	50.00	200	10	5.00		300	15	7.50	
Ferro-alloys	40.60	33	1½	.67		33	1½	.67	
Total metal		2123	106	$17.98	$17.98	2124	106	$19.93	$19.93
Operating costs				6.10	9.55			6.10	9.55
Cost of steel in ladle				$24.08	$27.53			$26.03	$29.48
Cost of steel in castings:									
Cost of steel in ladle ÷ 65 per cent				$37.05	$42.35			$40.05	$45.85
Less credit for heads, etc., as scrap				4.62	4.62			4.62	4.62
Net cost of steel in castings				$32.43	$37.73			$35.43	$40.73

Table VIII.

Crucible steel.

Raw materials.	Price of raw materials, per 2,000 pounds.	Per 2,000 pounds of steel in ladle. Weight used, pounds.	Per cent used.	Cost.	Weight used, pounds.	Per cent used.	Cost.
Wrought iron	$25.50	1360	68	$17.34	....	....	.....
Foreign steel scrap	14.50	....	..	.....	1330	66½	$9.64
Heads, gates, etc.	14.00	660	33	4.62	660	33	4.62
Ferro-alloys	40.60	12	½	.24	12	½	.24
Defective castings	125.00	10	½	.63	10	½	.63
Total metal		2042	102	$22.83	2012	100½	$15.13
Operating costs				35.00			35.00
Cost of steel in ladle				$57.83			$50.13
Cost of steel in castings:							
Cost of steel in ladle ÷ 66 per cent*				$87.62			$75.95
Less credit for heads, etc., as scrap				4.62			4.62
Net cost of steel in castings				$83.00			$71.33

*Of the steel in the ladle 66 per cent goes into castings, 33 per cent goes into heads, gates, etc., 1 per cent is lost in pouring.

Electric Steel Process.

The electric steel-making process has two advantages over the crucible process. First, it can use the cheapest form of steel scrap available in the market and second, it can turn out the highest grade of steel made, the electric furnace surpassing all others in its control over the phosphorus, the sulphur, the temperature and the gases dissolved in the metal.

The cost of making steel by the electric process is shown in Table IX, which is based upon figures furnished by the makers of some of the important furnaces and from published results of actual steel-melting operations on a commercial scale. It is evident that the chief factor in the cost is the price at which electric power is available, and therefore five different estimates are made accordingly.

Table IX.

Electric process.

Raw materials.	Price of raw materials, per 2,000 pounds.	Per 2,000 pounds of steel in ladle. Weight used, pounds.	Per cent used.	Cost.
Steel scrap	$9.50	1330	66½	$6.32
Heads, gates, etc.	14.00	660	33	4.62
Defective castings	125.00	10	½	.63
Ferro-alloys	40.60	12	½	.24
Total metal		2012	100½	$11.81

Cost of electric power per kilowatt hour, cents.	Cost of steel in ladle.	In casting.
1	$28.81	$39.03
2	37.96	52.89
3	47.11	66.76
4	56.26	80.62
5	65.41	94.49

It is thus evident that the electric process can hardly hope to compete in cost of production with any of the prevailing processes except the crucible process, and then usually only when electric power is available at 3 cents per kilowatt hour or less. It may well be, however, that recent developments in the electric process will bring its cost down to the point where the converter process will be superseded to some extent, especially in view of the very high quality of electric steel. This question, however, is not to be taken in any sense as a prophecy. The cost of the electric process available only for large tonnages of castings is materially lower than those given above, but the cost of installation of this type of electric furnace is so large that many immediate replacements are not probable.

In conclusion, we wish to say that we have not given above the cost of any individual plant. This statement is made in justice to those with whom the writer has been connected.

THE MANUFACTURE OF BRASS INGOTS*

Their uses and advantages---Recent improvements in the product---Disadvantages of purchased scrap---Comparative low cost of Ingots

BY W. M. CORSE

IN accordance with the scientific spirit that is gradually finding its way into brass foundry practice, the foundryman of today is investigating his raw materials as never before. Competition demands that he take advantage of every point that tends to decrease costs. Managing the foundry economically is the keynote to success in any brass manufacturing business, so that a saving in the purchase of metals is one of the first things that is looked after by the modern brass foundry superintendent or foreman.

Ingot brass is not a new product. Ask any experienced foundryman and he will tell you that it is a material that is made up after the formula of sausage and is liable to contain as many things that are bad for brass as army canned beef once did for the soldier. He had good grounds for this opinion and he must not be considered an "old fogey" if he sticks to it tenaciously, for it is only within a few years that this stigma on ingot brass has begun to be removed and those cases are just beginning to attract serious attention.

It is the purpose of this paper to give an account of the manufacture of high grade ingot brass so that the foundryman may understand something about it and why it is now extensively used in castings in which the use of the ingot was not allowed a few years ago.

Early Prejudice.

The reason that ingots were generally bad is the fact that most of them were made from skimmings, grindings and low grade borings, which did not find a ready market. These were generally sold at lower prices to attract the foundrymen. The result of this practice gave ingot brass a bad name.

To overcome this prejudice, experiments have developed the following method with good results: It consists in using a mixture of red brass borings and copper together with any white metals that may be necessary to bring the mixture to a definite composition. Some ingot makers use a certain percentage of brass washings, while others consider a strictly high grade metal should not carry washings in its mixture.

We will assume that the ingot is to be made from borings and copper only. Experience has shown that brass ingot made from the average borings alone as found on the market, is often unsuited for good castings.. This condition is due to the oxidation of the finely divided metal during melting and to the excess of impurities generally present. To overcome this, a certain percentage of new metal must be added. This is generally copper, either in the form of ingot wire or clippings. The amount added varies according to the composition of the borings used, but is generally from 20 to 35 per cent of the melt. This addition of new metal makes an ingot that can be readily cast into sound clean castings which are easily machined.

Sorting the Borings.

The borings are first dumped on the floor, each barrel being carefully inspected for aluminum, manganese bronze and other detrimental material before being added to the main pile. The usual weight for such a pile is from 10 to 25 tons. This pile is next thoroughly mixed preferably by means of a mechanical mixer. When the mixing is finished, a sample barrel of at least 500 pounds is taken from different portions of the pile in such a way that it will be thoroughly representative of the lot. This sample is run through a magnetic separator to remove the iron particles. Then the metal is melted in a large crucible with the proper fluxes, thoroughly stirred, skimmed and poured into ingots. Several of the ingots are drilled and the drillings sent to the laboratory for analysis. From the analysis, the amount of copper and other metals needed to bring the ingot to the formula desired, is calculated. Even though the analysis shows more copper than the formula calls for, new copper is necessary in order to give to the material the properties desired. Often, another sample pot is made up with the addition indicated by the first analysis and this analyzed, in order to be sure that the formula will give the composition wanted. Ingots made as carefully as above described should have an average variation in the copper content for example, of not more than 0.33 per cent. From this you can see that such an ingot can be used in particular work, that is, where the composition must be maintained within certain relatively close limits.

Cost.

As indicated previously, the cost of ingot brass is generally from ½ to ¾ of a cent a pound less than the same composition made from new metals. This enables the foundryman to give for the same price, a better metal than his competitor can give who is not using ingot brass; or what amounts to the same thing, it enables the foundryman to produce his castings at a lower cost.

In order to standardize both the cost and the composition so that the stocks carried, both by the consumer and the smelter, may be low, a standard formula ingot is generally made up. This formula is approximately 82 per cent copper, 4 per cent tin, 6 per cent lead and 8 per cent zinc. As all these metals carry impurities even in the virgin state, a certain allowance must be made for these when buying on chemical analysis. The total impurities should not exceed 1 per cent. Variations in composition are also allowed for in the specifications for it is impossible to make an exact formula even with new metals.

*Presented at the annual meeting of the American Brass Founders' Association.

A standard specification might be as follows:

	Per cent.
Copper within	0.5
Tin within	0.1
Lead within	1
Zinc within	1
Iron less than	0.35
Antimony less than	0.35
or it may be stated as	
Copper not less than	82
Tin not less than	4
Lead not more than	7
Zinc not more than	9
Impurities not more than	1

Impurities.

It is difficult to say what amount of impurities are injurious because what is harmful for one mixture or class of castings may not injure another class in the slightest. Several investigations have shown me, however, that the amounts of impurities mentioned are harmless. Furthermore, as methods of analysis are perfected, it sometimes happens that a definite amount of a metal present may give different results with the different methods. This has been proven in the case of iron. What was supposed at first to be an accurate method for iron gives only about 50 per cent of the iron shown by another and evidently more accurate method. The iron was present nevertheless in both cases and the foundryman obtained equally as good results with the metal. This instance goes to show that the consumer and smelter must stand ready at any time to change their conceptions of the harmful amount of an impurity as more accurate chemical work gives them the true content. Comparatively little work has been done in a practical way to determine the upper limits of impurities that may safely be allowed, but as we progress further along the lines of exact knowledge by the help of the testing laboratory, we shall soon be in a position, I hope, to give more accurate information on this subject.

Ingots Cheaper Than New Metal.

Some of the first questions naturally asked are: How can the smelter afford to sell an ingot brass below the cost of new metal; and why can a smelter produce a better ingot than the brass founder can make himself? In answer to the first, I would say that buying any material in large quantities at all times, generally enables a concern to buy for less money and a concern whose business it is to buy continually can get the class of material needed to better advantage. Regarding the second question, I would say that the average foundry can not afford to carry in stock enough borings of the various kinds needed to make a good ingot because of the large amount invested. Furthermore, all borings do not run alike so that, as they are found on the market, it is often necessary to mix as many as three or four lots to make the desired composition without adding too much new metal. The addition of new metal, especially copper, is necessary to make a first class ingot, but in amounts over 35 per cent it increases the cost so that no saving can be made, a result not to be desired by either consumer or smelter. Then again, the average founder would have to melt relatively small amounts, which would necessitate an increased number of analyses and would increase the cost to him, by increasing his fuel, cost of handling and loss of metal.

We must take into account, also, the fact that any manufacturing operation, to be carried on cheaply, always necessitates special equipment, which, if not kept in operation continually, costs more than it should. Even extra floor space costs something in the final calculation. The average foundry does not feel able to engage the service of an expert chemist or metallurgist to look after the melting operations. The smelter, however, is always glad to extend to the consumer such service in consultation as will be of benefit to him in the products turned out. So we see that even though it may seem wise to make ingot brass in the average brass foundry, it will appear evident, when all the items of expense are considered, that the saving in buying from a smelter is bound to be more than it would appear at first.

So little work has been done in this field, especially in alloys containing more than two metals, that one can not predict what will develop within the next few years. The iron and steel industry has given us many examples of the value of this sort of investigation and metallurgists are beginning to apply the same principles to the non-ferrous alloys with very interesting results. This only goes to emphasize the fact that the brass industry is just awakening to its possibilities and that the modern foundryman must avail himself of every opportunity to learn if he would keep to the front. It is the realization of the facts stated above that has led some smelters to produce an ingot of exact composition so that the foundryman may have exact knowledge of the metals that he is using.

A few years ago, the average foundryman relied on scrap when he used old metals. What are some of the disadvantages of scrap as ordinarily bought? From the nature of the material, no guarantee can be made as to its composition, neither can one tell readily if any objectionable alloys are present. The appearance almost wholly governs the judgment of its quality. This immediately opens the way for the introduction of lower grade material into the higher grade in percentages that are largely determined by the ability of the consumer to sort properly. The selling price of scrap is generally high enough so that any lowering of its average quality means a very decided loss to the consumer. Scrap always carries a certain percentage of dirt and foreign materials which make the shrinking in melting higher than that of ingot metal. This shrinkage is a variable quantity and makes it difficult again to determine the value of the scrap. We can easily see, therefore, that in the matter of composition and of shrinkage, the ingot presents a decided advantage. In some cities the consumption of scrap has fallen off very noticeably within the past two years, its place having been filled by ingot brass. The apparent saving in the ingot is not as great as in scrap but the actual saving is more. The high price of copper during the years 1903 to 1907 tended to a lowering of the quality of all brass. Scrap reflects this condition so that its present average value is often less than that estimated. The value of a guaranteed ingot is never uncertain on that account.

Advantages of Ingot Brass.

The description of the manufacture of high grade ingot brass makes it evident that a higher price must be asked for it than for the old style ingot or for scrap brass. A careful analysis of the situation, however, reveals the fact that the difference in price is more apparent than real and should not be construed as an arbitrary increase on the smelter's part.

To summarize, let me mention the six principal points of advantage in using ingot brass. They are:

1. Uniform composition.
2. Low shrinkage in melting.
3. Decreased cost in handling.
4. Exact amount of impurities known.
5. Value received for the price paid.
6. Saving in first cost over new metals.

THE SMALL OPEN-HEARTH FURNACE*

Its use in the production of steel castings and its advantages compared with furnaces of the larger type

BY W. M. CARR

THAT the open-hearth process for the manufacture of steel is gradually gaining ground, can be proven by statistics. The reason for its supplanting other methods is mainly one of quality. Furthermore the basic open-hearth process permits a mixture of pig iron and miscellaneous steel scrap of a lower grade and cheaper price than the raw material necessary in other processes.

With the foregoing facts in mind, the author presents this article for the consideration of prospective investors in the manufacture of steel castings in small, moderate and large tonnages. To be more explicit, small tonnages include units of one-half, 1 and 2 tons per heat, moderate tonnages, 2 to 5 tons per heat, and large tonnages, 10 to 25 tons per heat.

In presenting these claims it is with the recognition of the following advantages:

First.—The small capacity furnaces cost less to install than any other steel-making devices excepting only crucible melting furnaces.

Second.—The economy of operation.

Third.—The certainty of results, the greater degree of control in operation and the reduction of the personal equation to the lowest possible degree.

Large Open-Hearth Furnaces.

The largest production of steel castings is from open-hearth furnaces of capacities from 5 to 25 tons per heat. Such practice is established and it requires a constant demand to be profitable as well as an investment of considerable capital varying with the size of the plant. It has been generally believed that capacities of less than five tons per heat were not possible by open-hearth methods, and engineers have dissuaded those who desired to engage in the manufacture of steel castings, either for their own consumption or the trade, from using open-hearth methods, since until quite recently the tendency has been rather to increase the capacity of the open-hearth supposedly for economical reasons rather than to build small units with less capacities.

The author, however, has had the opportunity of demonstrating the possibilities of the miniature open-hearth and has found from actual practice that it is economical, comparing operating costs with standard capacity furnaces. It can safely be said that the operating cost of the miniature open-hearth is less than that of any type of steel producing unit or process making steel in equal quantity.

To those who may not be familiar with an open-hearth furnace and its operation, a reference to the accompanying illustration may prove instructive. The upper part of the furnace is represented in sectional elevation. The structure is built of refractory bricks bound securely with structural steel beams and plates at certain points not shown. The lower part of the furnace, usually below the charging floor level or carried below the shop level, consists of the regenerator chambers, connecting flues leading to a reversing valve and thence to a stack. The hearth is practically a shallow dish lined with silica sand fused into one solid mass at a high temperature at the time of making bottom. This is the laboratory where the raw material is melted and refined to steel of any desired composition. In outline, the practice is as follows and refers to the operation of a miniature open-hearth fired with fuel oil, recommended in preference to producer gas in capacities of less than 5 tons per heat.

Operation of Miniature Open-Hearth.

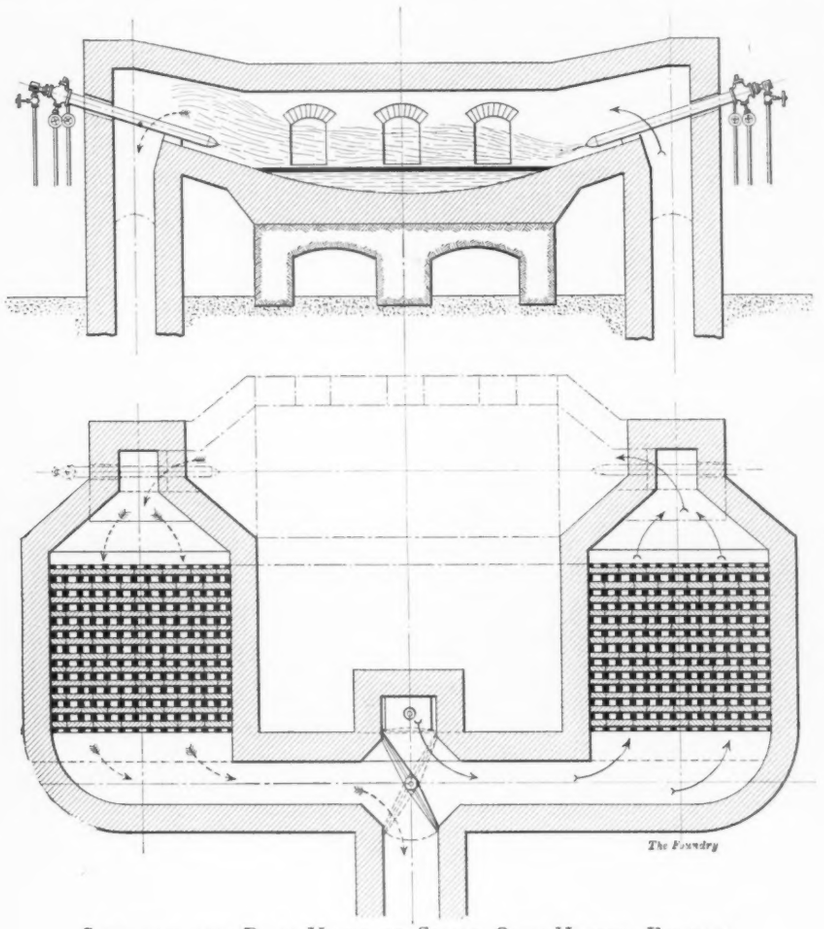
After the furnace has been brought up to a working temperature—white heat—a mixture of acid pig iron and low phosphorus steel scrap, in usually the following proportions—one-third pig and two-thirds scrap—is charged into the furnace, adding the pig iron first, and when that becomes molten it is followed by the scrap. The whole mass subsequently becomes liquid from the heat of the oil flame passing above it. At this stage the temperature of the furnace is reduced by the addition of the cold stock, but it will still be at a temperature above that required to melt pig iron. To raise the temperature above that required to melt steel and have it in condition to pour, the advantage of the principle of regeneration is available, which consists in returning to the furnace, waste heat which in other types of furnaces escapes to the stack. Without a system of regeneration it is not possible to reach a proper steel casting temperature, that is to say, a reverberatory furnace without regeneration gives a temperature, where the combustion of the fuel is supported by cold air, less than that required to properly liquify steel, but with the principle of regeneration applied to such a furnace high temperatures are readily reached.

Utilization of Waste Heat.

To understand this principle we will follow the course of the flame of the burning oil as indicated by the arrows in the illustration. Beginning at the right, oil is delivered to the burner shown surrounded with a water-cooled casing to protect the burner fittings. The oil is delivered either by gravity or pump pressure, but before reaching the end of the burner it is atomized or vaporized by compressed air. This air is designated as primary air and performs little or no part in supporting combustion of the oil vapor, and the quantity of air delivered above the amount necessary to promote combustion of the oil is known as secondary air. The secondary air enters the reversing valve, shown at the stack connection, passes through the regenerator on the right, enters the uptakes

*Presented at the Cincinnati convention of American Foundrymen's Association.

below the water-cooled burner casing, performs its function and passes along the roof of the furnace, in part, and the remainder, mixed with the products of combustion with the strata of flame playing above the bath, enters the downtake at the left end of the furnace and in its passage to the stack gives up the major portion of its heat to the large amount of brick-work piled within the chamber. When the waste gases have passed through the reversing valve and entered the stack they have just about enough heat to induce the necessary draft. Now, after an interval



SECTIONAL AND PLAN VIEWS OF SMALL OPEN-HEARTH FURNACE

of 20 to 30 minutes, the burner on the right may be shut off, but not withdrawn from the furnace, the reversing valve is thrown and the oil and primary air turned on at the left end of the furnace. The secondary air will then be diverted by the reversing valve to flow through the left regenerator or checker chamber, and passing through innumerable passages in that set of checkers absorbs large volumes of heat radiating from the glowing bricks which became heated by the outgoing gases during a previous cycle of operation. This radiated heat, regenerating the secondary air, will be added to the temperature generated by the burning fuel and the products of combustion will accordingly have an increased quantity of heat units to deposit in the checker work at the outgoing or right end. In other words, whatever temperature may be carried in by the secondary air will be equivalent to an increase in efficiency of the burning fuel. Successive reversals of the fuel, primary and secondary air, produce constantly increasing increments in flame temperatures slightly below the melting point of the refractory brick-work. We have seen what can be accomplished by storing up and restoring to the furnace, waste heat from the products of combustion, producing the effect of a higher possible temperature than in any type of melting furnace. In addition, the reflection of heat from the walls and roof of the furnace upon the surface of the bath of metal, known as radio-activity, is more pronounced in a narrow melting chamber than in a wider one, and consequently there is a lower fuel consumption together with the possibility of superheating the steel in this miniature open-hearth. This has not been recognized heretofore, since most open-hearth furnaces are fired with producer gas, and since that fuel requires peculiar furnace construction to get the best results in burning it, it has not been found possible to make use of such fuel in a comparatively short furnace hearth and therefore, all furnaces designed to use this fuel must have a comparatively long hearth tending mainly in the direction of increased capacities rather than decreased output. On the other hand, the length of the hearth is not restricted where oil can be substituted for producer gas and therefore it has been found possible to operate an open-hearth furnace as small as 350 pounds capacity per heat. Thus a new field is opened for making steel by the open-hearth process.

Chemical Reactions.

Referring again to the operating method, we saw where the bath of metal was molten and at a moderate temperature. This temperature was due to the highly carburized condition of the metal since the presence of carbon lowers the melting point of iron. We saw how it was possible to gradually increase the temperature of the furnace by the regeneration of the secondary air, and with that constant elevation of temperature, dormant chemical actions will be set up. The first effect will be an oxidization of the silicon occurring mostly on the surface of the metal by the oxidizing action of the flame. The product would be silica which combines with whatever oxide of iron might be present in the bath of metal. The combination would form a slag of comparatively light weight that would rise to the surface and cover the bath. The slag is shown in the illustration by the heavy black line. This layer of slag prevents the metal below from coming into direct contact with the flame.

Carbon.

After the removal of the silicon, the next action is the removal of the carbon. This is a gaseous action and will cause bubbling or a boil throughout the bath. The action can be augmented from time to time by the addition of iron oxide in the form of iron ore. As the decarborization progresses, test plugs are taken from time to time, the operator judging the amount of carbon in the bath by their fracture and malleability. When the carbon has decreased to a predetermined point, the boil may be stopped or killed by deoxidizing

agents such as ferro-silicon and ferro-manganese, in properly weighed amounts. The metal can then be transferred to molds. This method as outlined refers to the acid process. In it the elements, sulphur and phosphorus, are not removed. The basic process necessitates a hearth lining made of magnesite. Such a lining permits an addition of limestone to form a slag which will absorb the two elements and make a purer steel, chemically speaking, than the acid process, and at the same time allows the use of cheaper raw materials than the acid process.

With open-hearth furnaces designed to use producer gas and which rarely go below five tons capacity, it is not possible to adapt them to intermittent operation. Even in the smaller producer gas fired furnaces the roof span is considerable, resulting in heavy stresses on the side walls and binding. These stresses will vary as the furnace may be heated and cooled, and if such alternations are frequent there is danger of collapse of the furnace. It becomes necessary, then, to maintain them at a steady temperature, continuously. Unless there should be demand for regular tonnage the fuel consumption during idle periods would be a constant expense.

In miniature open-hearth furnaces, owing to the comparatively narrow hearth chamber, the roof span is of course lessened, and therefore, whatever expansion or contraction there may be following heatings and coolings, will result in comparatively slight stresses, and these results decrease in effect with the lessened capacity furnaces, and they therefore lend themselves with greater ease and lessened liability of repairs to intermittent operation. The miniature open-hearth is most satisfactory in the rolling type with the body cylindrical, so that the stresses, even though slight, will be evenly distributed, whereas in a rectangular form the roof will always rest and thrust upon the inside walls. In fact the miniature open-hearth is not recommended to be built in the stationary type.

In conclusion, the miniature open-hearth is not costly to install, is comparatively simple to operate, gives results equal to standard open-hearth practice, makes hotter steel than the regular open-hearth and can show costs equally as low per pound of molten metal in the ladle.

CONTINUOUS MELTING IN WESTINGHOUSE FOUNDRY*

BY S. D. SLEETH

WHEN the Westinghouse Air Brake Co. found it necessary to enlarge its plant, on account of increased business, it was decided to move to Wilmerding, Pa., and install in the foundry, flask and sand conveyors. This meant that the foundry would have to operate so that iron could be poured all day, instead of two or three hours in the afternoon. We knew of no plant where this was being done, so it was up to us to work it out. As it required about 2½ hours to run off the heat at that time, we decided to see how much longer we could hold the metal in the cupola and still keep it hot. The first day we put the blast on one-half hour earlier and melted the iron with the same blast pressure, but would shut off the blast for five or ten minutes and then start to blow again. This we found worked satisfactorily. The second day we put the blast on one hour earlier, but this did not work so well, we therefore added more coke, which kept the metal hot but the melting was slower.

When we started work in the new foundry at Wilmerding we ran two cupolas, one in the morning and one in the afternoon. We were afraid to hold the iron over the dinner hour. After running for some time in this way we decided to run one cupola all day; at 11 o'clock, or a little later, we added 200 pounds of coke for two or three charges so that we would have an extra amount of coke to hold over the dinner hour. Our great trouble at this time was with the cupola tender, who insisted that the iron would freeze at the tapping hole, but we finally persuaded him that he would not be held responsible should this occur. We drained all the iron at 12 o'clock, closing the slag hole with sand, stopped the tapping hole, and shut all other openings so there would be no draft. About ten minutes before starting time we tapped out all that was in the cupola and pigged it, then put the blast on full, so as to be ready when the starting whistle blew. Sometimes we have to pig 200 or 300 pounds on account of the metal not being hot enough.

We had two cupolas, 48-inch and 60-inch inside the lining. When the heats were heavy we would run the 60-inch. We had to enlarge the plant again so we took out the 48-inch cupola and installed two new cupolas, the shells being 90 inches, so that we could line them up to 78 inches if required. We have them lined at the present time to 70 inches. When running full, night and day, we melt 280 tons, running each cupola about ten hours. We have operated one cupola from Friday night at 6 o'clock until Saturday noon of the following day, closing down at 11 p. m. for one-half hour for lunch, and again at 6:30 in the morning for three-quarters of an hour for breakfast. This is rather hard on the lining so we do not make a practice of it.

We have tried a great many experiments with cupolas, but as yet have been unable to find any that will give better results than those provided with a double row of tuyeres, the upper row about 10 inches above the lower. It is not necessary to keep the upper ones open all the time. Our blast pressure is about 11 ounces in the cupola bustle. We use a fan for blast. When running full we melt 10 to 11 pounds of iron to one pound of coke.

In charging the cupola we are very careful to have the charge level. We charge the pig by hand and the scrap is dumped in from a buggy through a door above the regular charging door. All the charges are the same from beginning to the end of the heat. As the iron must come very soft and uniform we do not charge more than 4,000 pounds at one time. For a smaller cupola the charge would naturally be less.

To sum up our experiences, I would advise that the coke bed be burned even all around and the charge made as for an ordinary run, allowing an extra amount of coke for the dinner hour. After running about one hour, open the slag hole and keep it open, except during the dinner hour. Use about 40 to 50 pounds of limestone to one ton of molten metal—better to use too much than too little. Have the cupola shell large enough, as it is easy to put in an extra lining for smaller heats.

*Presented at the Cincinnati Convention of the American Foundrymen's Association.

A NOVEL POWER-RAMMING MACHINE

The sand is conveyed from the heap by an elevator belt to a screw from which it is directed onto a packer belt into the flask

A POWER-RAMMING molding machine, exceedingly novel in design and construction, which packs the sand in the flask by projecting it against the pattern at a high velocity, is being successfully operated in the plant of the Ferguson & Lange Foundry Co., Chicago, where the machine was developed. The principle employed for ramming the sand is similar to that governing the movement of the hand molder, who frequently throws balls of sand, compressed in the hand, against the pattern to insure the proper density of the sand in deep pockets, and over very irregular surfaces. For projecting the sand into the flasks and against the pattern, a belt conveyor is used, provided with cleats at regular intervals. The sand is delivered to this belt by a screw conveyor, which receives its supply from another belt conveyor, the lower end of which is located over the sand pile. The machine, with the conveyor from which the sand is projected, above a flask on a stripping plate molding machine, is shown in Fig. 1, and a side elevation of the same is illustrated in Fig. 5.

The operating mechanism is carried in a rocking frame supported by a four-wheeled truck which travels upon parallel lateral arms, and by its movement upon the same, permits of the ramming of the molds at any point within the radius of the machine. These arms are also vertically adjustable on the turn-post which can be revolved upon its base and permits the raising and lowering of the sand projecting conveyor to the height of the flask in which the mold is to be made. In Fig. 2 the machine has been swung about on the turn-post in position for making a mold on another part of the floor. The conveyor from which the sand is projected is pivotally suspended and is, therefore, universally movable, as shown in Figs. 3 and 4, and thus permits the sand to be directed into every part of the flask. When making a mold the machine is swung around the turn-post and is moved radially by means of the truck so as to bring the delivery end of the packer over the flask. Sand is shoveled onto the elevator belt over which a screen is placed, thereby riddling the sand again. The sand is then delivered to the screw conveyor in the rocking frame and is discharged into the packer casing from which it is projected by belt into the mold. The packer belt travels at a high speed, greatly exceeding gravity speed, so that the sand entering the casing is engaged and projected by the cleats on the belt at a high speed into the flask. The operator fills all parts of the flask by moving the delivery end of the packer in all directions so as to uniformly distribute the sand. As the sand is all projected into the flask at the same speed, it is packed with relatively uniform density throughout.

A plan view of the rocking frame, to one end of which is attached the electric motor that drives the ma-

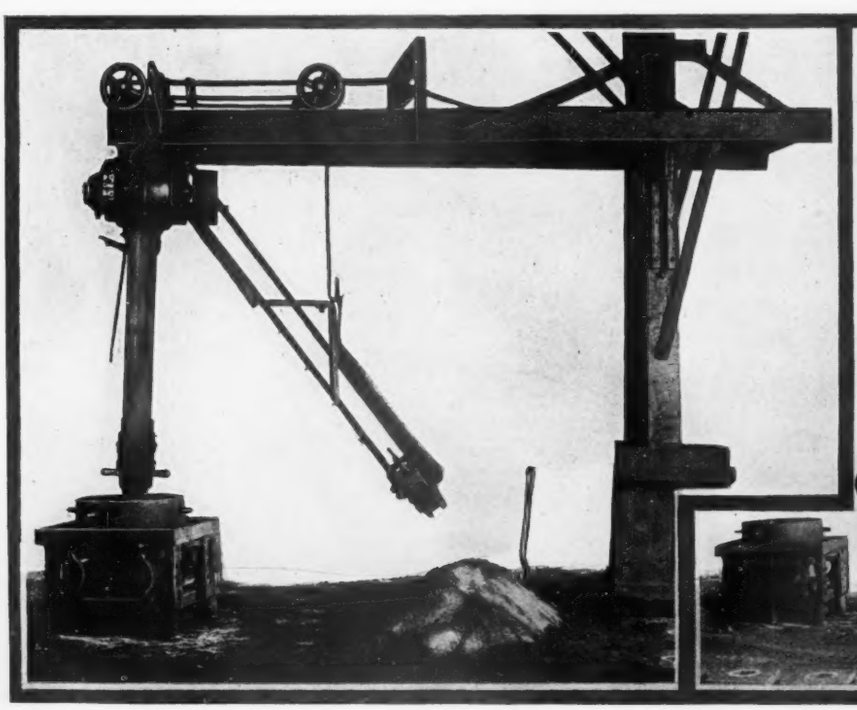
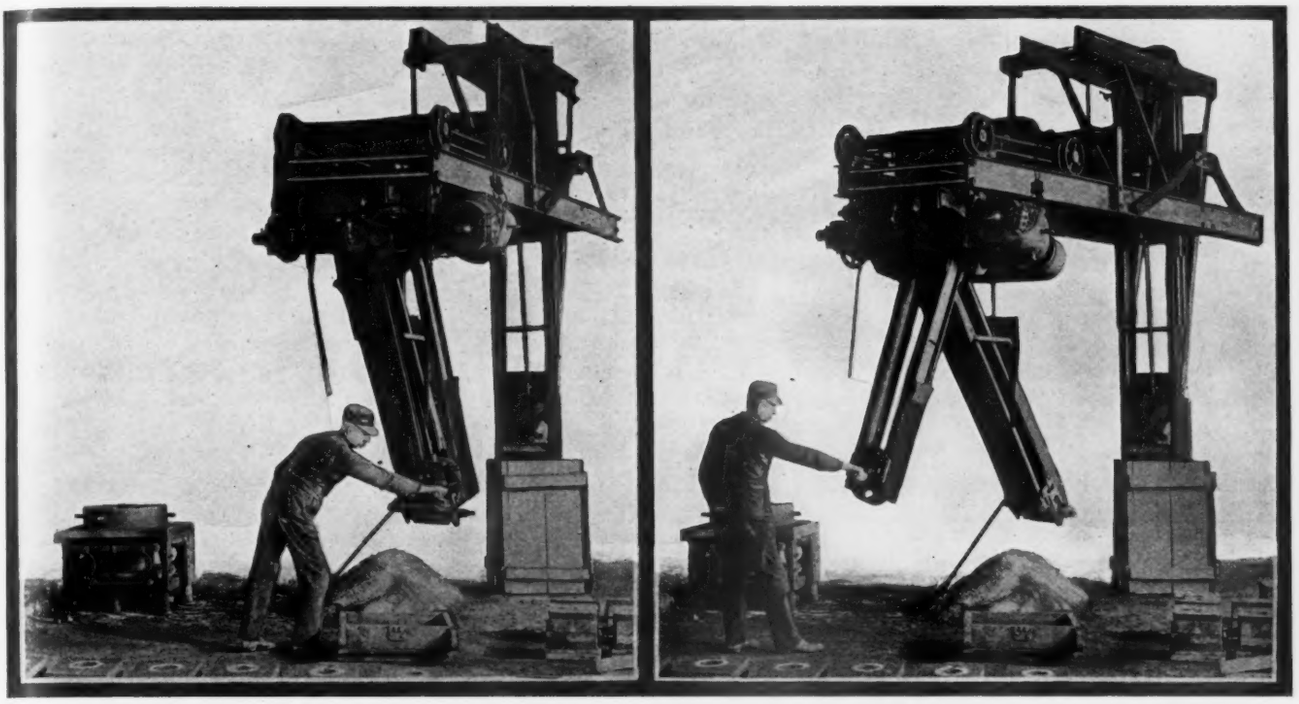


FIG. 1—POWER-RAMMING MOLDING MACHINE WITH SAND PROJECTING BELT CONVEYOR OVER THE FLASK

FIG. 2—MACHINE SWUNG AROUND ON THE TURN-POST SHOWING THE OPERATING MECHANISM



FIGS. 3 AND 4—THE SAND PACKING BELT CONVEYOR IS UNIVERSALLY MOVABLE, PERMITTING THE SAND TO BE DIRECTED INTO EVERY PART OF THE FLASK

chine, is shown in Fig. 6. The machine is set in motion by means of a friction clutch pulley controlled by a lever depending from the rocking frame within easy reach of the operator, as shown in Fig. 1. The spiral conveyor mounted on a shaft is located in this frame as well as the pulley over which the elevator belt is trained and which delivers the sand to the conveyor. This belt also passes over an idle pulley, shown in Fig. 9, mounted in bearings that can be adjusted by set screws to take up any sagging in the belt. The frame in which this belt operates is pivotally suspended from a shaft in the rocking frame so that it can be raised and lowered, and at its upper end it is provided with a delivery spout through which the material is carried to the screw conveyor. The packing belt is also trained over a pulley mounted on a countershaft, Fig. 6, and at the discharge end it passes over a pulley carried by a shaft in the lower portion of the frame which is pivotally suspended from trunnions. The belt is provided, at regular intervals, with cleats that engage the sand, and is entirely enclosed with a casing excepting at its ends. The walls of the casing are so disposed as to leave very little space between the inner faces and cleats, so that no sand may pass without being engaged by the cleats.

The casing communicates at its upper end with the delivery side of the screw conveyor chamber, and the entire casing may be swung by the handles attached to its lower end, as shown in Figs. 1 and 4. To prevent the sand from dropping out of the screw conveyor chamber while the packing frame is being swung when making a mold, a sealed joint is provided. Cleats are also attached to the sand elevator belt, Fig. 9, which do not extend its entire width, but leave a free space on either side. The side plates of the frame are provided at the lower ends with flanges which form a contracted, flaring passage into which the sand is fed. Fastened to this frame is an inverted, L-shaped arm to which a rod, suspended from the truck, is secured by a hook. By adjusting this

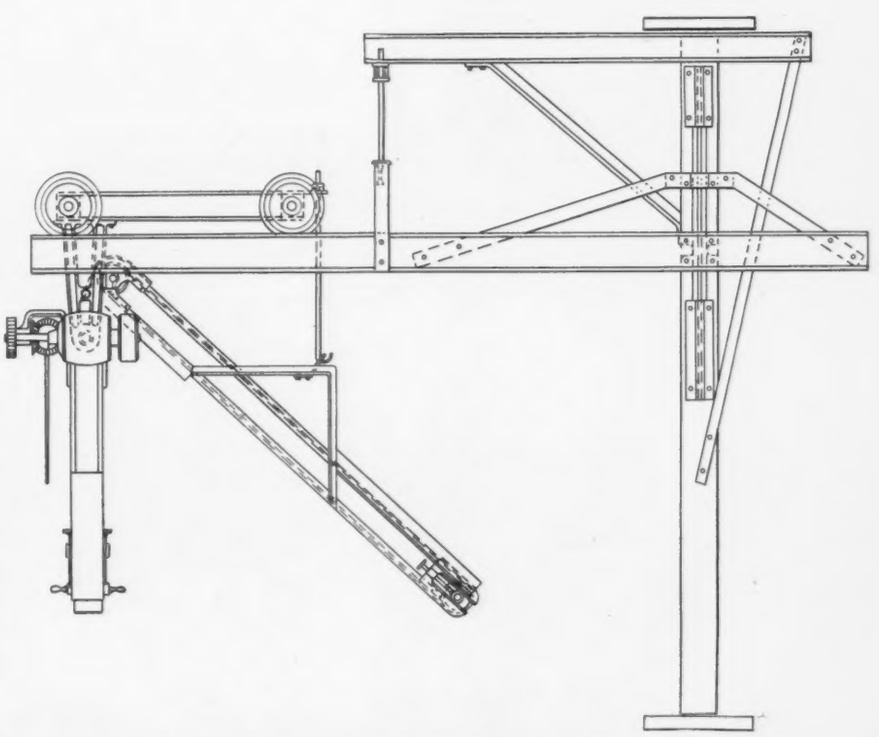


FIG. 5—SIDE ELEVATION OF POWER RAMMING MOLDING MACHINE

rod the elevator belt frame may be raised or lowered, and by varying the angle, the quantity of sand which may be elevated is varied without changing the speed of the belt. A variable speed motor is used and the controller is attached to the turn-post.

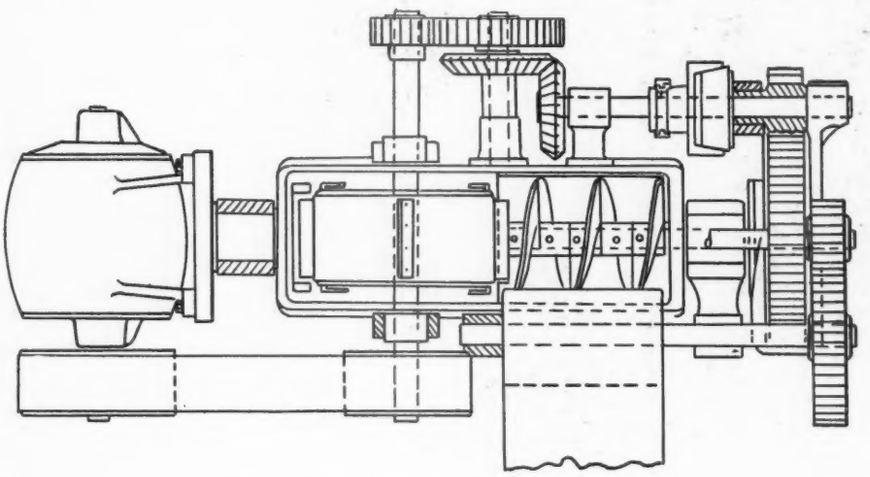


FIG. 6—PLAN VIEW OF THE ROCKING FRAME

The firm name of the Case Mfg. Co., Columbus, O., builders of electric and hand power cranes and hoists, has been changed to that of the Case Crane Co.

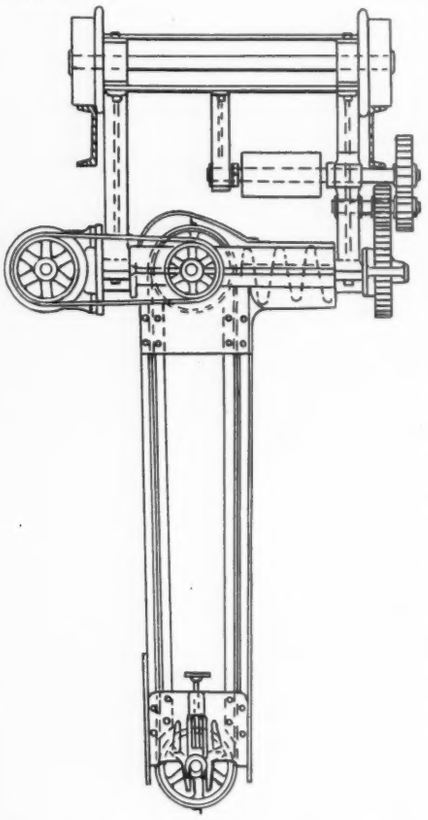


FIG. 7—END ELEVATION OF THE MACHINE, SHOWING THE TRUCK AND THE SAND ELEVATOR

HARD SKIN ON CASTINGS.

BY W. J. KEEP

Question:—We recently shipped a carload of No. 2 foundry iron which analyzed as follows, and was the average of six analyses from six samples: Silicon, 2.13 per cent; sulphur, 0.017 per cent; phosphorus, 0.371 per cent; manganese, 0.48 per cent; graphitic carbon, 2.60 per cent, and combined carbon, 0.63 per cent. The foundryman using this iron claims that the castings made therefrom are so hard that they must be annealed before they can be machined, and that castings ½-inch thick and under will chill clear through. He claims that he used 50 per cent of this iron and 50 per cent of machinery scrap. The coke used was of good quality. We received a section from a pipe, 3⅜ inches outside diameter, and the outside of this casting seems very hard. It cannot be easily filed or machined. On the other hand the inside of the casting is soft and can be readily filed. This foundryman claims that when he substitutes another iron containing silicon, 2.72 per cent; phosphorus, 0.882 per cent; sulphur, 0.018 per cent, and manganese, 0.56 per cent, the difficulty disappears. The physical appearance of both irons is identical.

Answer:—Such an experience is very common in a stove plate shop and we recently had this difficulty. We had considerable trouble with a sample car of pig iron and the chemist employed by the furnace from which it was shipped did his best to ascertain the cause. The castings from which the surface was to be removed by a polishing wheel could not be cut. Generally, the molds from which the hard castings were poured were made by one molder and the castings poured in the molds made by another molder were invariably soft. By exchanging patterns the same man would make hard castings, while the other molder would make soft castings. When this communication was received we were having trouble with a number of castings and we had a molder pour two molds of the same pattern from one ladle, and he was instructed to shake one out of the sand while red hot and leave the other in the sand until the floor was poured. Both were marked and given to the polisher who could not cut the casting taken out of the sand while red hot, and the other casting which was permitted to remain in the sand was easily polished. We are of the opinion that we suffer more from a hard skin on castings during cold weather, which would be natural. Annealing at a fairly low temperature will remove all traces of hardness. It is likely that some irons contain a higher percentage of combined carbon than the other elements would seem to indicate. This is probably the result of some treatment in the blast furnace. The cure seems to be to leave the castings longer in the sand.

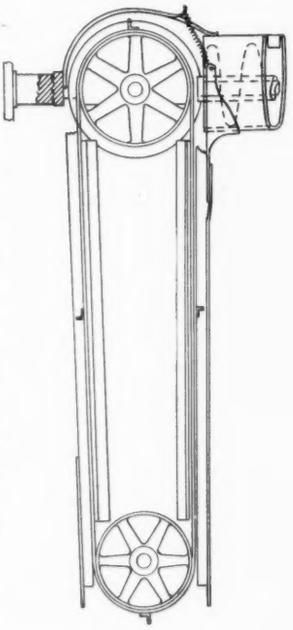


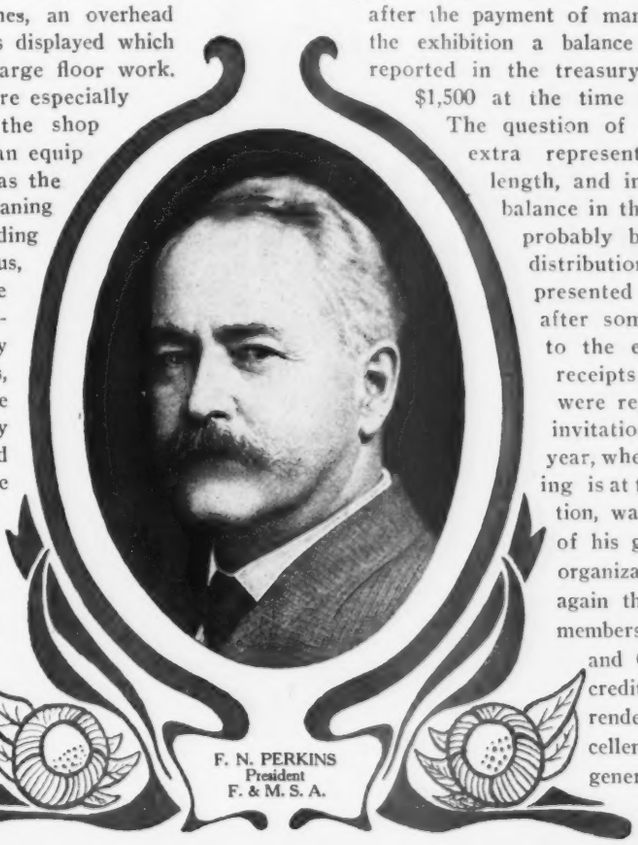
FIG. 8—LONGITUDINAL SECTION OF PACKER BELT AND SUPPORTING FRAME

FIG. 9—SECTIONAL VIEW OF ELEVATOR BELT AND SUPPORTING FRAME

THE FOUNDRY EQUIPMENT EXPOSITION

Held in Cincinnati during Founders' Week--Extensive display of molding machines--Meeting of the Foundry and Manufacturers' Supply Association

MUSIC HALL, Cincinnati, was converted into a model foundry during "Founders' Week," May 17 to 22. The exhibits, more numerous and elaborate than heretofore, occupied the entire main floor and furnaces, ladle heaters, mold dryers, core ovens, etc., were housed in an adjoining building especially built for this occasion. One of the noteworthy features of the show was the molding machine display. It included all types for various classes of foundry work, both large and small, and the progress in mechanical molding during the past year, exemplified by the numerous new types shown, proved a revelation to the visiting foundrymen. Demonstrations were made daily and the molds produced varied in weight from a few pounds to 5 tons. The spectacular operation of the large machines attracted considerable attention, and from experiments already made it is evident that molds weighing up to 25 or 30 tons can be successfully molded by machine. To complete the sequence of operations of the large jolt ramming molding machines, an overhead pattern-drawing, roll-over device was displayed which can also be successfully used on large floor work. Many of the machines exhibited were especially adapted for jobbing work, and the shop producing miscellaneous castings can equip for mechanical molding as readily as the specialty foundry. All kinds of cleaning machinery was also displayed, including tumbling mills, sand blasting apparatus, etc. That foundrymen generally are devoting more time to the preparation of their sand was indicated by the number of sand mills, mixers, grinders and conveyors shown. One large mill installed in the temporary building elevates the sand, mixes and tempers, and delivers it onto the floor ready for use. Every conceivable device for the core room was also on display, including core machines for stock and irregular cores, core coning and cutting-off machines, core sand mixers, core racks and stationary and portable core ovens. Considerable space was also devoted to woodworking machines for the pattern shop, and a mechanical woodworker, intended to effect great economies in the production of patterns and core boxes, was shown in operation. Several Cincinnati machine tool builders who made displays were so favorably impressed with the exposition that they have decided to reserve considerable space next year for operating exhibits, and the indications are that equipment for the machine shop, as well as the foundry, will represent no small part of the 1910 show. The temporary building resembled a model brass foundry, inasmuch as it contained the displays of various types of brass melting furnaces and practical demonstrations were made daily to show their method of operation. Ladle heaters, mold dryers, foundry torches and other equipment were also shown in this annex.



F. N. PERKINS
President
F. & M. S. A.

The annual meeting of the Foundry & Manufacturers' Supply Association, held at the Hotel Sinton, Friday evening, May 21, was well attended by the members of this organization. Secretary C. E. Hoyt reported a total membership of 105, 21 having resigned during the year and 26 new members were enrolled since Feb. 1. From the sale of space in Music Hall and the temporary building, approximately $8,400 were realized, and the dues received since the first of the year netted about $2,500 additional. Together with the income from other sources, the total receipts since January 1 amounted to about $13,000, and after the payment of many expenses connected with the exhibition a balance of practically $6,000 was reported in the treasury, as compared with only $1,500 at the time of the Toronto meeting. The question of the payment of $5.00 for extra representation was discussed at length, and in view of the comfortable balance in the treasury this charge will probably be waived this year. The distribution of souvenirs was also presented for consideration and after some discussion was referred to the executive committee. The receipts from admission to the hall were reported at about $1,000. An invitation to meet in Detroit next year, where a large exposition building is at the disposal of the association, was presented. In recognition of his good work in behalf of the organization, F. N. Perkins was again the unanimous choice of the members for the office of president, and C. E. Hoyt, to whom great credit is due for the able service rendered exhibitors and the excellence of the arrangements generally, was elected secretary and treasurer. The officers elected are as follows:

President, F. N. Perkins, Arcade Mfg. Co., Freeport, Ill.

First vice president, F. B. Stevens, Frederic B. Stevens, Detroit.

Second vice president, R. S. Buch, A. Buch's Sons Co., Elizabethtown, Pa.

Third vice president, S. T. Johnston, S. Obermayer Co., Chicago.

Fourth vice president, Wm. Lodge, Lodge & Shipley Machine Tool Co., Cincinnati.

Trustees, three year term: E. A. Pridmore, Henry Pridmore, Chicago; Geo. H. Wadsworth, Falls Rivet & Machine Co., Cuyahoga Falls, O.; H. R. Atwater, Osborn Mfg. Co., Cleveland.

To fill the unexpired term of S. T. Johnston as trustee, E. J. Woodison, Detroit Foundry Supply Co., Detroit.

ARCADE MFG. CO., Freeport, Ill.—All of the molding machines exhibited by this concern were operated, and included the latest types of Modern machines provided with pneumatic vibrators and tripping attachments, as well as 15-inch and 26-inch Norcross jolt ramming machines, having capacities for ramming molds weighing from 6,000 to 25,000 pounds. In addition to a miscellaneous line of castings produced on the machines built by this concern, a handsome display was made of castings produced on Modern machines in the plant of the Michigan Stove Co., Detroit. Represented by E. H. Morgan, C. Morgan, F. N. Perkins, H. Tscherning, N. Burton and W. C. Norcross.

BARNETT, OSCAR, FOUNDRY CO., Newark, N. J.—Complete line of interchangeable foundry flasks. Represented by Frank S. Barnett.

BARTLEY, JONATHAN, CRUCIBLE CO., Trenton, N. J.—The exhibit in this booth was attractively arranged and included a complete line of standard crucibles, as well as special pots for tilting furnaces, stoppers, nozzles and other graphite products. Four handsomely decorated porcelain crucibles, intended only for "melting diamonds," attracted considerable attention. Represented by Jonathan Bartley.

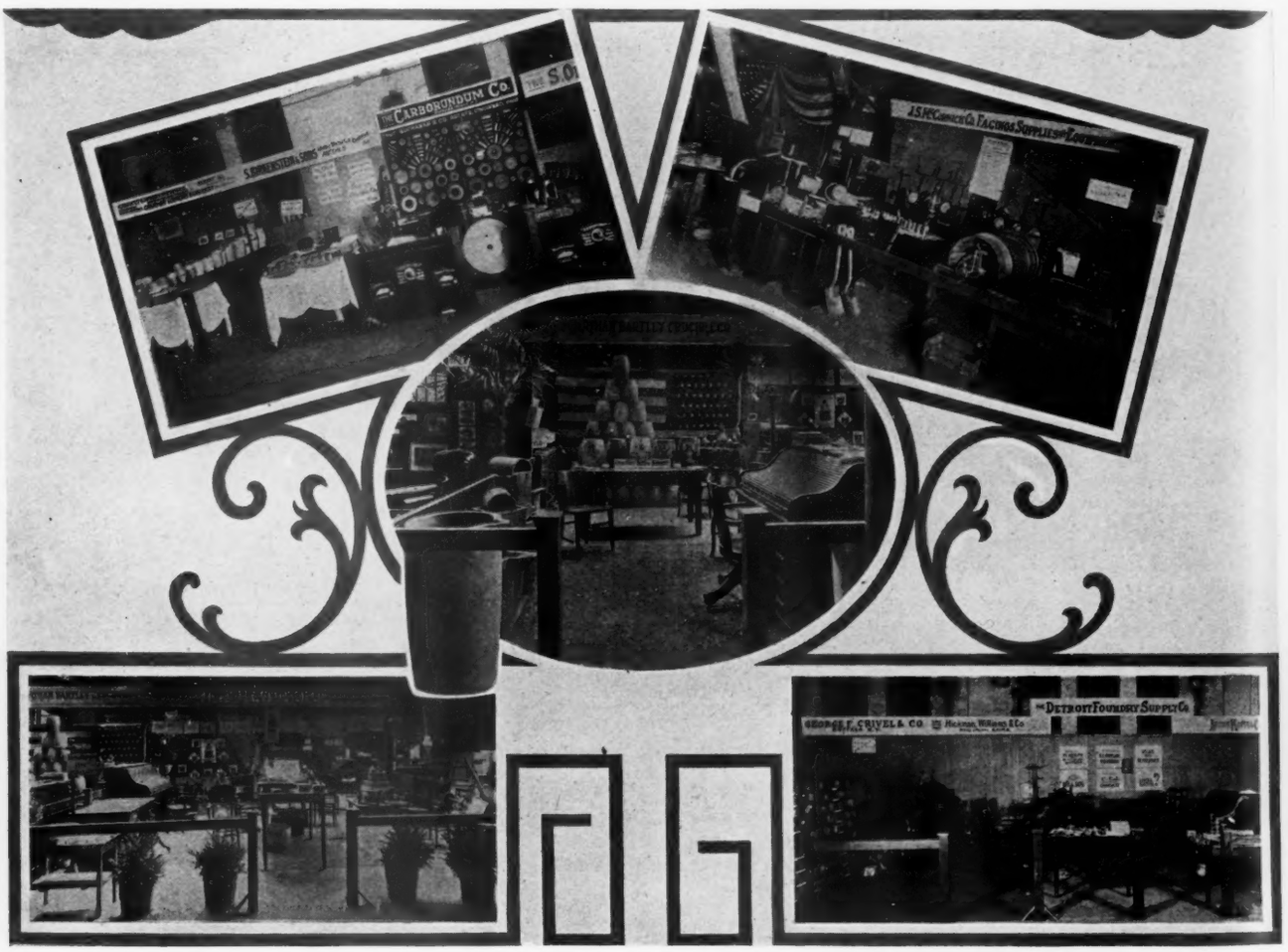
BERKSHIRE MFG. CO., Cleveland.—The automatic molding machine made by this concern was shown in operation, as well as a hand squeezer, pattern drawing molding machine described in THE FOUNDRY, April, 1909. Represented by J. N. and C. E. Battenfeld.

BIRKENSTEIN, S., & CO., Chicago.—All kinds of metals were displayed including ingot brass, copper, manganese bronze ingots, as well as crucibles made by the Taunton Crucible Co. Represented by S. M. Rush, J. B. Neiman, E. E. Berliner and J. McCormack.

BROWN SPECIALTY MACHINERY CO., Chicago.—This concern had in operation its combined power and hand-driven Hammer core machine, core tapering machines, core cabinets; sample cores and diamond pattern lumber were also shown. Represented by E. A. Rich.

BROWNING ENGINEERING CO., Cleveland.—This concern distributed printed matter showing its various types of cranes, buckets, hoists, etc. Represented by H. E. Green and Victor R. Browning.

BUCH'S, A., SONS CO., Elizabethtown, Pa.—The gravity molding machine operated by this concern attracted considerable attention. Molds were made at stated intervals throughout the day. The machine was equipped with an automatic air hoist and jib crane to facilitate the handling of flasks and molds. The Parks portable molding machine, aluminum snap flasks and other equipment were also shown. Represented by R. S. Buch, C. A. West, J.



CALUMET ENGINEERING WORKS; S. BIRKENSTEIN & SONS; THE CARBORUNDUM CO.

J. S. MCCORMICK CO.

JONATHAN BARTLEY CRUCIBLE CO.

THE HILL & GRIFFITH CO.

GEO. F. CRIVEL & CO.; HICKMAN, WILLIAMS & CO.; DETROIT FOUNDRY SUPPLY CO.

Exhibits.

ALLYNE BRASS FOUNDRY CO., Cleveland.—The action of "Homogen," an alloy for removing impurities from metals having a copper base, was demonstrated in the temporary building by its application to metals melted in the "M. R. V." furnace displayed by J. B. Wise, Watertown, N. Y. Represented by C. P. Mebane.

AMERICAN SMELTING & REFINING CO., Cincinnati.—Samples of copper, brass, zinc, lead, aluminum, solder, babbitt metals, etc., were displayed in this booth. Represented by H. Cantor.

J. Potter, S. H. Chapman and Edmund Stanley. The latter two represented the Ontario Wind Engine & Pump Co., Toronto, Canadian sales agent of the gravity machine.

BURROUGHS ADDING MACHINE CO., Detroit.—Complete line of adding machines. Represented by F. D. Wilde.

CALUMET ENGINEERING WORKS, Harvey, Ill.—A model of the Calumet cupola was displayed as well as foundry ladles, air hoists and other equipment. Represented by R. A. Duggan, O. G. Lewis, Raymond Sculley and John D. Krieger.

Castings, Cleveland.

Canadian Machinery, Toronto.

CARBORUNDUM CO., Niagara Falls, N. Y.—The products made by this concern were attractively displayed and included carborundum wheels and stones, emery cloth, rubbing bricks, carborundum fire sand, and a new abrasive known as "Aloxite," adapted for steel, which contains from 90 to 97 per cent silicon. Represented by G. R. Rayner, W. W. Sanderson and H. A. Eaton.

CENTRAL FOUNDRY SUPPLY CO., Columbus.—Acme parting, various grades of facings, snap flasks and other foundry supplies were displayed by this concern. Represented by J. S. Ball and Wm. Fenton.

CHICAGO PNEUMATIC TOOL CO., Chicago.—This concern furnished a 14 x 16-inch, motor-driven air compressor which provided compressed air for the exhibitors. Represented by W. C. Walker.

CLEVELAND WIRE SPRING CO., Cleveland.—This space was attractively fitted up with a complete line of shop furniture, including steel barrels and boxes, trucks, core trays, etc., and all sizes of coiled wire spring. Represented by J. W. Campbell.

CRIVEL, GEORGE F., & CO., Buffalo.—This space was fitted up with desks, chairs, etc., for the comfort of visiting foundrymen. Represented by George F. Crivel.

CURTIS & CO. MFG. CO., St. Louis.—Castings were cleaned by the sand blast exhibited by this concern and an air compressor was also shown. The Curtis-Mumford overhead molder was also displayed handling flasks and drawing patterns from molds rammed on a large Norcross jolt ramming molding machine. Represented by E. H. Steedman.

DETROIT FOUNDRY SUPPLY CO., Detroit.—The invitation to "Rest Thy Weary Bones" suggests the disposition of the space reserved by this concern in the exhibition hall. It provided chairs, writing desks and tables for the use of visitors. Incidentally were shown the Bulldog shovel, Eureka blacking, extension cast iron chaplets, etc. Represented by E. J. Woodison and W. B. Howard.

DETROIT TESTING LABORATORY, Detroit.—This space was fitted up as an office.

DIAMOND CLAMP & FLASK CO., Richmond, Ind.—Complete line of core room equipment, including core machines of the plunger type, as well as conveyor and automatic machines. All of this equipment was shown in operation. The other devices displayed included core-coning and cutting-off machines; patternmakers' chuck and trimmer; snap flasks; slip jackets and a safety varnish can. Represented by W. W. Gartside and Geo. W. Piehl.

DIXON, JOSEPH, CRUCIBLE CO., Jersey City, N. J.—Complete line of graphite products including crucibles, stoppers, foundry facings, etc. Represented by Dudley A. Johnson, S. Mayer, W. J. Coane, John A. Condit, A. L. Hassis, Frank Krug, M. Brandon, George Neighbor, Sam Doughtery and Wm. Allen.

DOGGETT, STANLEY, New York City.—This display included numerous foundry supplies, such as Perfection parting, iron and steel cement, charcoal, lead, foundry talc and manganese dioxide. Represented by A. J. Johnson.

FALLS RIVET & MACHINE CO., Cuyahoga Falls, O.—This exhibit contained a complete line of core room equipment including a sand mixing and compounding machine for preparing sand, either for small bench work or core machines; a No. 1, ⅜ to 3-inch core making machine; one No. 2 machine with 36-inch hand wheel for making cores up to 7 inches in diameter by hand, and a No. 3 power core machine. In addition there were shown the Wadsworth portable core oven, core cutting-off and coning machine, sectional steel shelving for stock cores, gagger molds and the display of cores of special shapes was unusually complete. A structural steel framework was especially constructed by Mr. Wadsworth to carry line and countershafts, thereby making the exhibit self-contained, power being provided by 3½-horsepower motor. All of the core machines were fitted on iron tables provided with cast iron legs, thus insuring the absolute rigidity of the setting for the machines. Represented by George H. Wadsworth, John Reese and Chester Cox.

MILLER'S PRODUCTS CO. AND THE REGISTRATION BOOTH — J. A. FAY & EGAN CO.

FALLS RIVET & MACHINE CO.

OLIVER MACHINERY CO. — SAND MIXING MACHINE CO.; STERLING WHEELBARROW CO.

FAY, J. A., & EGAN CO., Cincinnati.—This exhibit included one No. 50 band saw, one 24-inch surfacer, universal rip and cross cut saw, and a 20-inch hand planer with draft attachment, all motor-driven. Represented by Clifford Egan and Wm. Krumer.

FOUNDRY SPECIALTY CO.. Cincinnati.—Fluxine, a flux for brass foundry use, as well as Partine, a parting compound, were exhibited. Represented by F. W. Weissman.

FOUNDRY, THE, Cleveland.

GOLDSCHMIDT THERMIT CO., New York City.—Demonstrations of the use of Thermit for welding shafts, pipe, etc., were made, and the exhibit included a complete welding outfit, as well as some of the rarer metals free from carbon. Represented by G. N. Guenther.

GULICK, HENDERSON & CO., Pittsburg.—The space of this concern was fitted up as an office and rest room for visiting foundrymen. Represented by J. W. Henderson.

HAUCK MFG. CO., New York City and Brooklyn.—All of the equipment in this exhibit was operated and included a ladle heater, burner for brazing pipe, two lead melting furnaces, heating torches, burners for skin drying molds, brazing forge, portable heaters and torches, and a burner for lighting cupolas. Represented by Arthur E. Hauck, A. B. Link and A. Stein.

HAWLEY DOWN DRAFT FURNACE CO., Chicago.—This concern made two exhibits, one in Music hall and another in the temporary building. The former consisted of a 90-inch, Schwartz tilting furnace having a capacity of 10,000 pounds, and a 32-inch Schwartz furnace with a capacity of 500 pounds. The Reyelbec crucible tilting furnace for melting brass, etc., having a capacity of 450 pounds was also shown. In the temporary building a 60-inch, Schwartz tilting furnace of 2,500 pounds capacity was shown in operation. Represented by C. E. Bleyer, C. M. Bleyer and T. P. Gurley.

HERMAN PNEUMATIC MACHINE CO., Zelienople, Pa.—This exhibit included a jarring molding machine provided with a pattern-drawing and roll-over attachment, and a large machine with a table 60 x 72 inches, which has a capacity for ramming molds up to 10,000 pounds in weight. A ladle barrow for conveying iron and pouring molds was also shown, and has a capacity of 250 pounds of molten metal. It affords a simple and economical means of conveying the iron from the cupola to the molding floors. Represented by Martin L. Heyl, John J. Lawlor and S. Wilkinson.

HICKMAN, WILLIAMS & CO., Cincinnati and Chicago.—Samples of the following brands of pig iron were shown: Standard, Watts, Dover, Carbon, Radford, Belfont, Embreeville, Woodward, Crozier, Bristol, Dora, Adrian, Red River, Tuscaloosa, Woodstock, Mary and Kittanning. Represented by Baylor Hickman, Frank Eaton, Ed. Hettiger, J. U. Beard, H. Black and R. S. Fox.

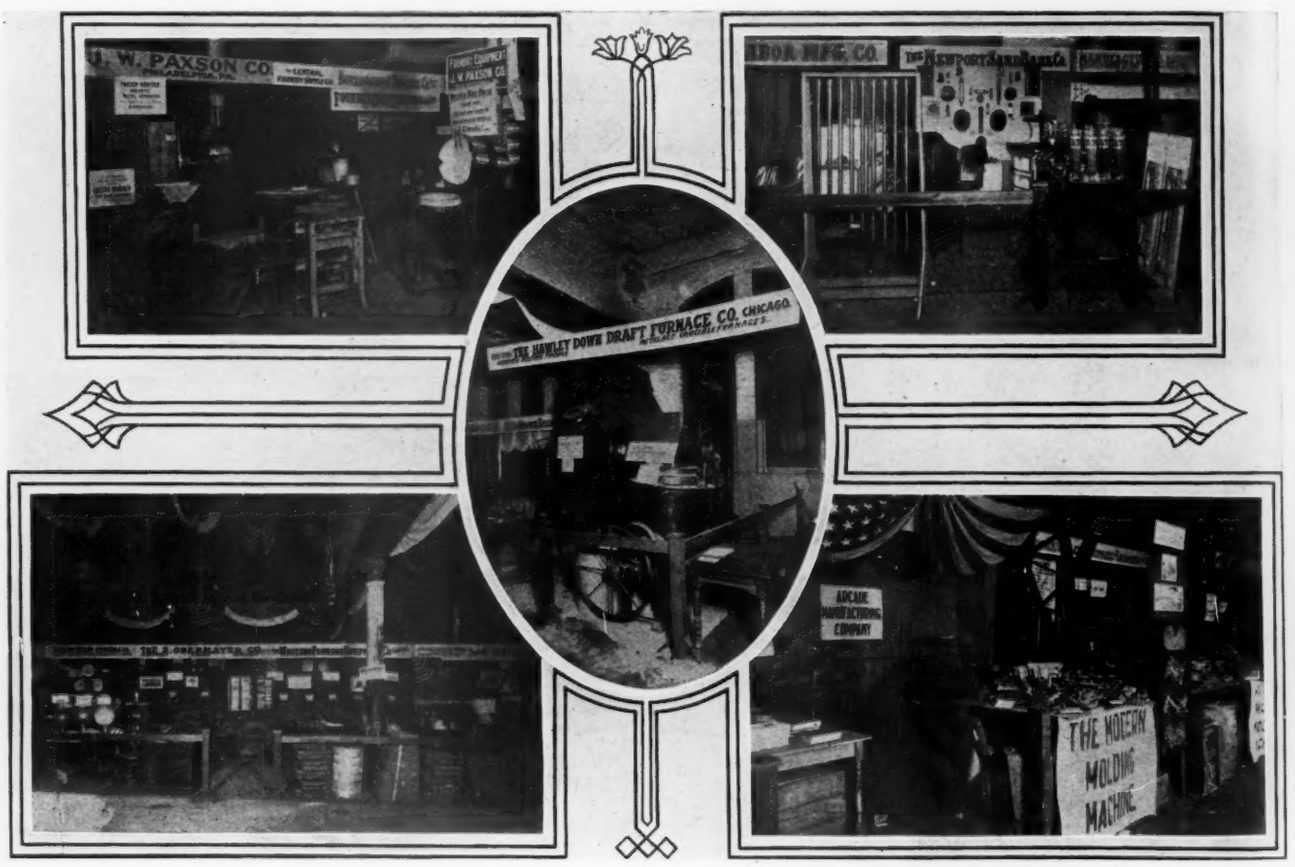
HILL & GRIFFITH CO., Cincinnati.—This booth was tastefully arranged and the exhibit of foundry supplies included samples of perforated chaplets, Facine for use in making fine art castings, electric surface grinders for grinding castings, wax wire machine, shovels, flasks, brushes, riddles and a general line of foundry supplies. Represented by John Hill and J. M. Glass.

HOLLAND LINSEED OIL CO., Chicago.—Daily demonstrations were made of the use of the various brands of core oil made by this concern. The cores were in the form of match safes, and after being baked were distributed as souvenirs. Among the core oils shown were the special linseed brand designed to take the place of straight linseed oil, Holland regular brand to be used in mixtures in the proportions of 60 to 1, Big Stick brand for mixtures from 40 to 50 to 1. Special oils for cores for aluminum castings and samples of water-proof paint were also shown. Represented by P. M. Baumgardner, Col. J. F. Boshoff, P. S. Crawford and Chas. Nelson.

Iron Trade Review, The, Cleveland.

KILLING'S, E., MOLDING MACHINE WORKS, Davenport, Ia.—The molding machines shown in this exhibit were operated throughout the entire week, and included several styles of roll-over machines, as well as one large roll-out machine, and a complete line of steel flasks were also shown. Represented by E. Killing.

KOPPEL, ARTHUR, CO., New York City.—Portable tracks, foundry cars, trucks, etc.,


J. W. PAXSON CO.
THE NEWPORT SAND BANK
THE HAWLEY DOWN DRAFT FURNACE CO. CHICAGO
ARCADE MANUFACTURING COMPANY
THE MODERN MOLDING MACHINE

J. W. Paxson Co.; Central Foundry Supply Co.; Burroughs Adding Machine Co.

Newport Sand Bank Co.

Hawley Down Draft Furnace Co.

S. Obermayer Co.; Whiting Foundry Equipment Co.

Arcade Mfg. Co.

comprised the entire exhibit. Represented by E. D. Seldon.

KROESCHELL BROS. CO., Chicago.—Of particular interest to the foundrymen in this exhibit was the new gas drying stove for skin drying molds which this concern has just placed on the market. In addition, this display included a complete installation of the Kroeschell-Schwartz gyrating flame crucible furnace, together with a direct-connected oil pumping system. Represented by William Kroeschell and E. H. Schwartz.

LANE & BODLEY CO., Cincinnati.—This concern exhibited a large cylinder of a 200-horsepower engine. Represented by Harry Lane and Floyd Minks.

LODGE & SHIPLEY MACHINE TOOL CO., Cincinnati.—Engine lathe, 24 inches x 12 feet, equipped with a patent head. Represented by Wm. Lodge.

MACLEOD, WALTER, & CO., Cincinnati.—Ladle heaters, mold dryers, torches for lighting cupolas and drying cores, oil furnaces, blow torches for skin drying molds, brazing, etc., sand blast machine, as well as water softeners and purifiers were shown. Represented by Walter Macleod.

MANUFACTURERS' EQUIPMENT CO., Chicago.—Two-jaw universal Aero chuck was exhibited. Represented by Paul J. Grevel.

METAL DROSS ECONOMY CO., Bristol, Conn.—Tank for cleaning dross. Represented by H. W. Hassis and W. H. Carpenter.

MILLERS' PRODUCTS CO., Chicago.—The exhibit made by this concern included samples of Black Diamond core compound and foundry flour. Represented by C. B. Spaulding, S. H. Baird, H. T. McGrath and Wm. J. Bryant.

MONARCH ENGINEERING & MFG. CO., Baltimore.—The brass melting furnaces that constituted the exhibit in the temporary building were operated. A new type of crucible tilting furnace with rocker cover operated by a lever was shown and was equipped with a side swinging crane which operated automatically to bring the shelf under the pouring lip of the furnace so that if desired the metal can be poured into ingots without oxidizing or chilling the same. This furnace can also be equipped with a swinging saddle which rests on the pouring lip of the furnace and will hold a bull ladle or crucible. Another furnace, equipped with a swinging crane and tongs to facilitate the lifting out of the pot, was also displayed. Other equipment shown included a portable core oven, 7 x 3 x 4 feet, lined with asbestos and provided with six roller type drawers; portable heaters for drying molds; oil heating furnaces, etc. Represented by David R. Steele, H. D. Harvey, James H. Fowler, M. W. Woodburn and E. H. Anderson.

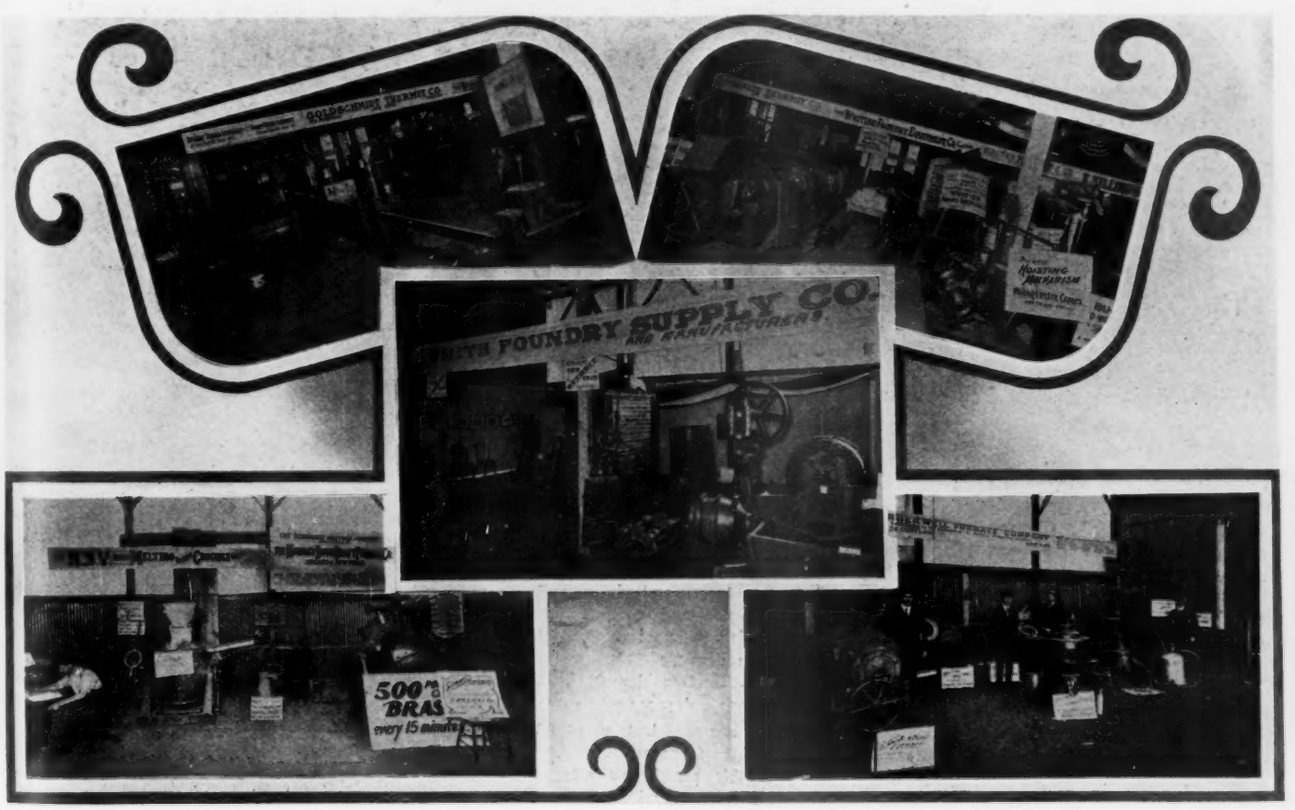
MUMFORD, E. H., CO., Philadelphia.—The molding machines displayed by this concern were operated and included one high trunnion, 10-inch squeezer; one 12-inch, plain power rammer, and one 13 x 18-inch, split pattern machine. Represented by E. H. Mumford and E. M. Zwing.

McCORMICK, J. S., CO., Pittsburg.—The magnetic separator displayed by this concern was operated and the exhibit also included a complete line of foundry supplies, large sand mixer, etc. Represented by J. S. McCormick, F. E. Malone and S. R. Costley.

NEWPORT SAND BANK CO., Newport, Ky.—Art hardware made in Newport sand was displayed, as well as enameled ranges, the castings for which were all made in Kentucky sand. A large assortment of stove castings were also displayed and samples of various grades of sand were shown. Represented by J. Frank Dye and G. W. Dye.

OBERMAYER, S., CO., Cincinnati.—This concern had two spaces, one furnished with chairs and desks for the convenience of visiting foundrymen, while the equipment and foundry supplies made by this concern were exhibited in the other. The equipment displayed included core ovens, flasks, sprue cutters, and among the supplies were included shovels, various facings, bellows and Kantbebeat core compound. Represented by H. F. Frohman, E. D. Frohman, Justus Thorner, Chas. Barker, J. E. Evans, L. A. Grossiger, W. Fitzpatrick, W. J. Adams, Geo. Kersting, F. J. Brunner, Herman Mende, J. C. Nuckols, S. T. Johnston, J. J. McDevitt and C. M. Goldman.

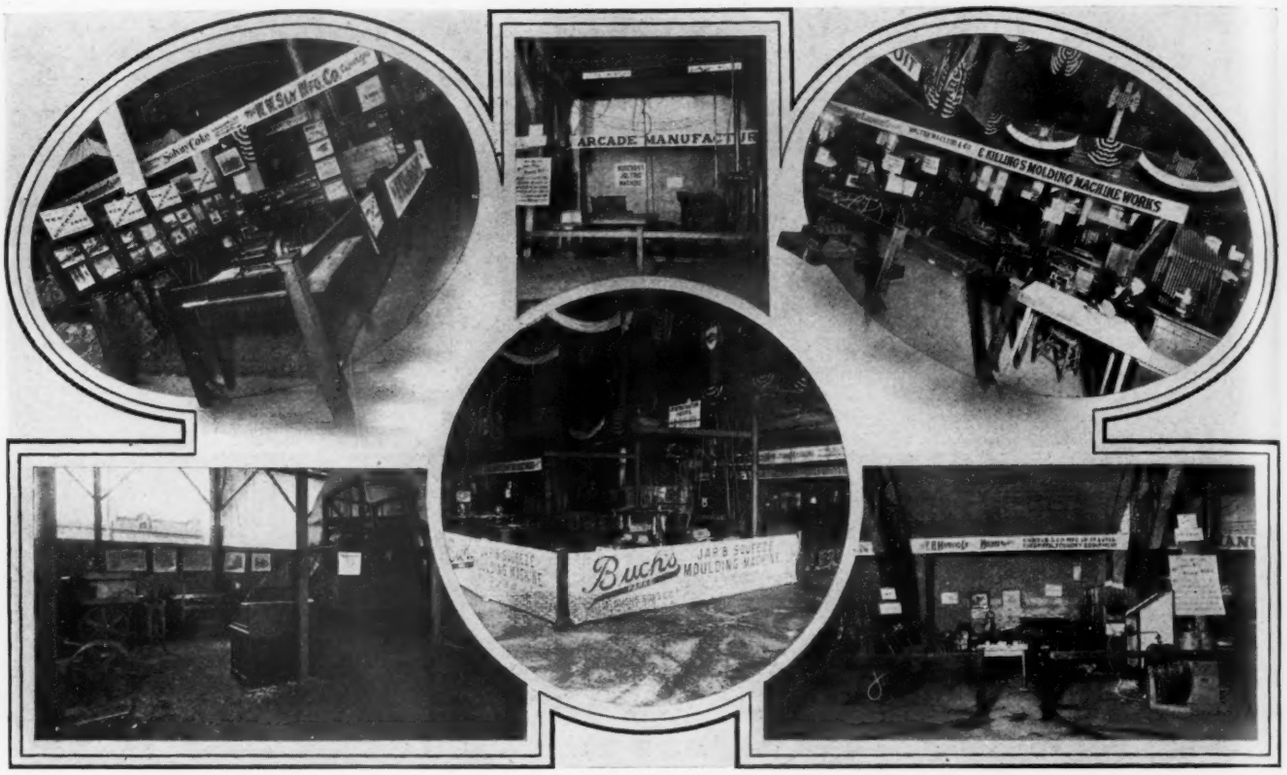
OLIVER MACHINERY CO., Grand Rapids, Mich.—The main feature of this exhibt was the Wadkin mechanical wood-worker described in THE FOUNDRY, May, 1909. In addition the exhibit included Nos. 3 and 9 wood trimmers, speed lathe, bench jointer, manual training and patternmakers' vise, together with a complete line of hand screws, clamps, pinch dogs, rapping plates, etc. Rep-



DETROIT TESTING LABORATORY; GOLDSCHMIDT THERMIT CO. WHITING FOUNDRY EQUIPMENT CO.

J. D. SMITH FOUNDRY SUPPLY CO.

J. B. WISE; HAWLEY DOWN DRAFT FURNACE CO. ROCKWELL FURNACE CO.



W. W. SLY MFG. CO. | CURTIS-MUMFORD OVERHEAD MOLDER | E. KILLING'S MOLDING MACHINE WORKS

STANDARD SAND & MACHINE CO. | A. BUCH'S SONS CO. | E. H. MUMFORD CO.; CURTIS & CO. MFG. CO.

resented by A. M. Spencer, W. Y. Mentzer and J. P. Schmidt.

OSBORN MFG. CO., Cleveland.—This concern exhibited its new rock-over, jolt-ramming molding machine designed for producing molds weighing up to 600 pounds; several rock-over, drop draft molding machines, together with a complete line of foundry brushes, bellows, wire wheels, riddles, etc. Represented by H. R. Atwater, F. D. Jacobs and J. A. Galloway.

PAXSON, J. W., CO., Philadelphia.—The exhibit made by this concern included a complete line of foundry equipment and supplies manufactured by this concern, including steel and bristle brushes, riddles, sieves, shovels, clamps, crucible tongs, rammers, air gages for cupolas, chaplets, torches and lamps, skimming rings for skimming brass, bronze, aluminum, iron and steel, air compressors, magnetic separators, ladles, aluminum snap flasks, molding machines, etc. Represented by H. M. Bougher, I. F. Kramer, Geo. W. Moore and L. A. Crandall.

PICKANDS, BROWN & CO., Chicago.—This concern, together with Baird & West, Detroit, had on display by-product coke for foundry use. Represented by Geo. A. S. Long.

PRIDMORE, HENRY E., Chicago.—All of the molding machines displayed in this exhibit were operated and included two small square stand machines fitted for molding spur gears; one stove plate rock-over machine; one stove plate rock-over drop machine; one 16 x 14-inch rock-over drop machine having a drop of 5 inches, fitted with a pulley pattern; one 29 x 24-inch rock-over drop machine having an 8-inch drop, fitted up for the production of large pipe fittings, and one power ramming, rock-over drop machine. Represented by E. A. Pridmore, H. A. Pridmore, D. Eagan, R. E. Turnball, W. W. Miller and W. H. Finney.

ROBESON PROCESS CO., Au Sable Forks, N. Y.—The space occupied by this concern was prettily decorated with palms, plants and spruce trees, and desks and chairs for the convenience and comfort of the visitors were provided. Samples of Glutrin, a core binder, were displayed. Represented by D. S. Robeson, H. N. Donald and H. L. Coe.

ROCKWELL FURNACE CO., New York city.—This concern had a complete line of metal melting furnaces in operation, including the double chamber, simplex tilting crucible, and lift-out crucible furnaces. An annealing and hardening furnace was also shown, together with a soft metal furnace, portable oil heaters, etc. Represented by W. S. Quigley, F. S. Garrett, W. H. Fitch, A. L. Stevens, S. L. Barnes and E. S. Davis.

SAND MIXING MACHINE CO., New York City.—The Auto sand mixer manufactured by this concern was shown in operation. Represented by D. E. Minich.

SELLERS, WM., & CO., INC., Philadelphia.—Two centrifugal sand mixing machines for mixing all kinds of foundry sand, core mixtures, etc., were shown in operation. Represented by Ed. L. Holljes.

SLY, W. W., MFG. CO., Cleveland.—A model of a water mill was shown, as well as photographs of tumbling mills and other equipment manufactured by this concern. Represented by W. W. Sly, W. C. Sly, H. R. Morse and D. Livensparger.

SMITH, J. D., FOUNDRY SUPPLY CO., Cleveland.—A large rolling type core oven was operated by this concern in the temporary building and a battery of natural draft brass furnaces was also installed. Equipment exhibited included a hand squeezer molding machine; a large sprue cutter, water tumblers; wall crane; pot lifter; sand blast apparatus; blacking mixer and cinder mill. Represented by F. A. Coleman, J. S. Smith, Jos. Harrison and M. S. Finley.

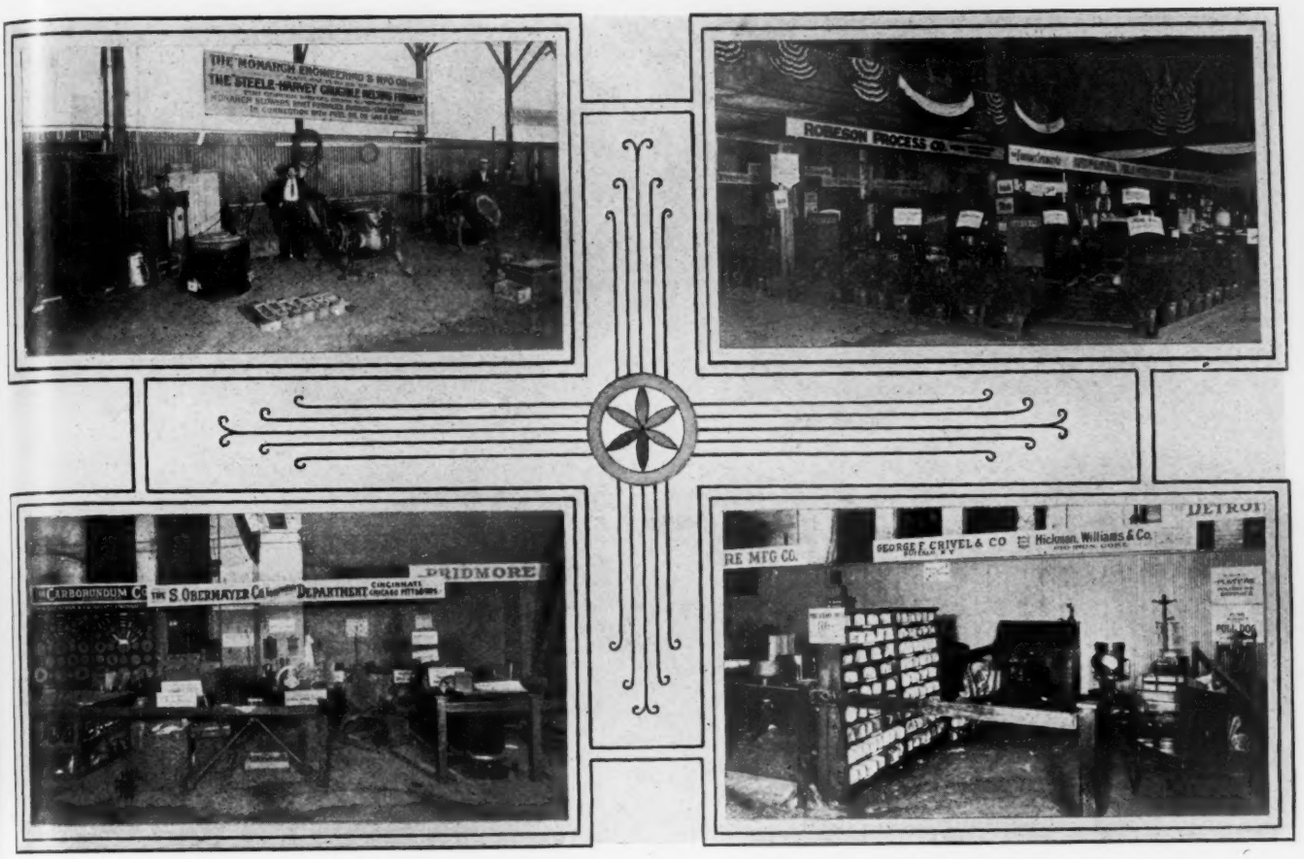
SQUIER, ED. E., & CO., St. Louis.—The exhibit made by this concern consisted of foundry sand, coal and coke. Represented by R. H. Squier.

STANDARD SAND & MACHINE CO., Cleveland.—The large sand mixer shown by this concern, which has a capacity of 15 tons per hour, attracted considerable attention. The machine is equipped with a power screening device which thoroughly proportions, mixes and screens the sand and delivers it onto the foundry floor ready for use. Represented by H. G. Boughton, F. J. Morgan, W. M. Smith and E. J. Smith.

STERLING WHEELBARROW CO., Milwaukee.—Foundry flasks made from rolled steel shapes were exhibited, together with a complete line of steel wheelbarrows, trucks and wedges for foundry use. Represented by I. R. Smith.

STEVENS, FREDERIC B., Detroit.—This space was fitted up as an office and rest room for the visiting delegates. Represented by F. B. Stevens.

TABOR MFG. CO., Philadelphia.—All of the molding machines exhibited by this concern were operated, and included one 30-inch roll-over, 12-inch draft machine; one 18-inch roll-over, 8-inch draft machine; one 14 x 16-inch split pattern machine, provided with hand draft; one 14 x 16-inch split pattern, power draft machine; one 10-inch squeezer; 40-inch Taylor-Newbold saw and two 8-inch Taylor-Newbold milling cutters with inserted, high speed steel blades. Represented by Wilfred Lewis, J. T. Ramsden, C.



MONARCH ENGINEERING & MFG. CO.
S. OBERMAYER CO.'S EQUIPMENT DEPARTMENT

ROBESON PROCESS CO.
GEO. F. CRIVEL & CO.; HICKMAN, WILLIAMS & CO.

W. Coleman, C. H. Ellis and J. H. Coleman.

WESTINGHOUSE ELECTRIC & MFG. CO., Pittsburg.—The temporary building was lighted with Cooper-Hewitt lights furnished by this concern.

WHITING FOUNDRY EQUIPMENT CO., Harvey, Ill.—This concern exhibited several tumbling mills, hoisting mechanism used on Whiting cranes, foundry hoists, as well as a drawer type core oven. Represented by J. F. Whiting, R. H. Bourne and T. S. Hammond.

WISE, J. B., Watertown, N. Y.—The M. R. V. tilting crucible furnace for melting brass and the softer metals was shown in operation. Represented by J. B. Wise and R. F. Goyne.

THE LENGTH OF TEST BARS.

By W. J. KEEP

Question:—We note that the distance between the chilling faces of the yokes of your apparatus for making mechanical analyses is 12⅛ inches, which does not give the correct shrinkage per foot of a test bar 12 inches long. Are we correct in our assumption?

Answer:—The same bar is used in many cases to make the test for transverse strength, and for this it was considered advisable to make the bar as near 12 inches as possible. The shrinkage of a gray iron test bar 12 inches in length will be more or less than 0.125 inch, and each variation of ⅛ inch in length would not cause more than 0.001-inch variation in the shrinkage. The variation in shrinkage shows a corresponding variation in the silicon and hardness, but it is the comparison with the shrinkage of the same for each day with the conditions remaining unchanged. The iron mu t be caught at the same part of the heat and should be cooled to practically the same temperature continually, when measured. The test bar must lie the same as the pattern in the same yoke in which it was cast. If there are no variations in conditions and you have decided what shrinkage you had when your castings were satisfactory, then an increase in shrinkage as compared with that standard shows that you need more silicon and vice versa. It is the variation from the standard that you want and all that is necessary is that the test bar is the same and that the conditions remain unchanged from day to day.

STANDARDIZING FOUNDRY FACINGS*

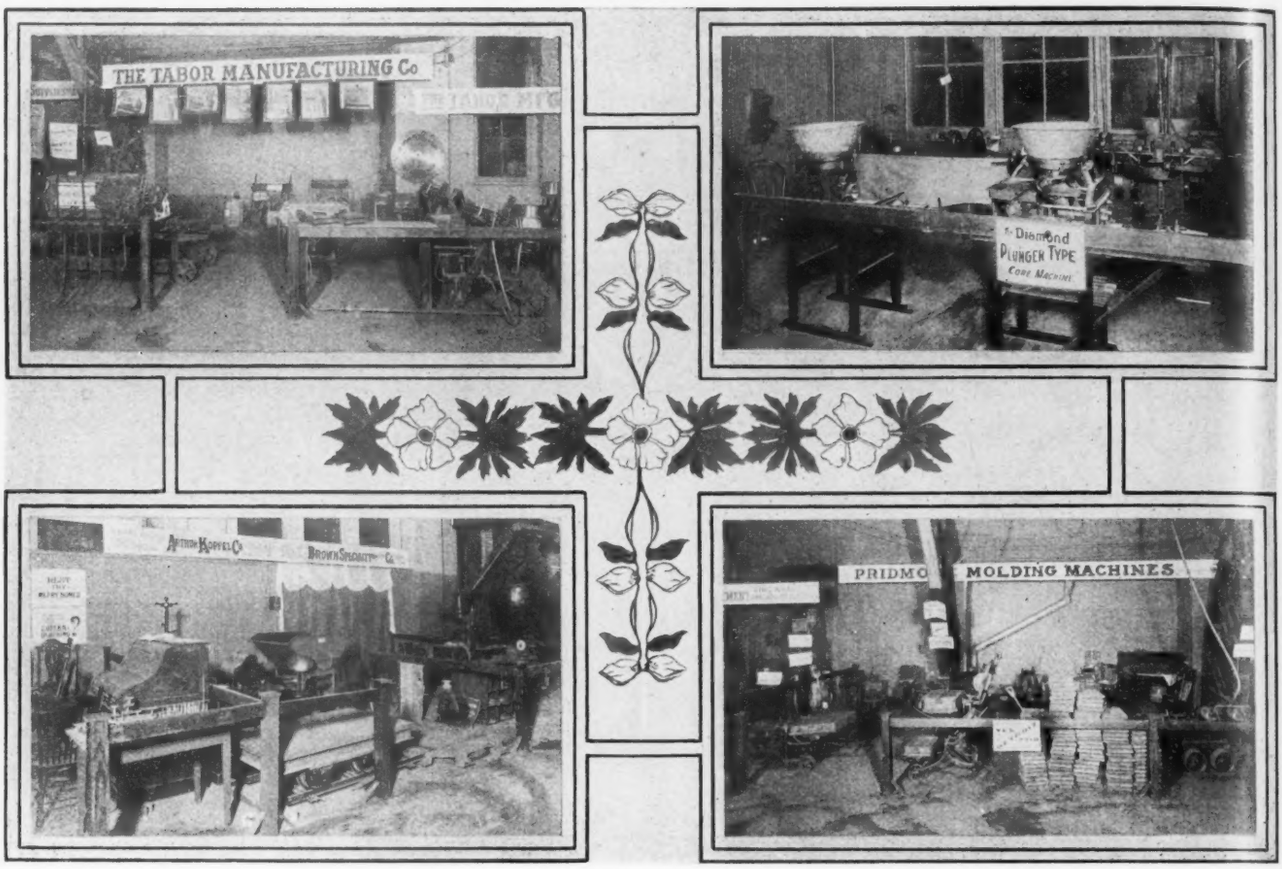
BY H. F. FROHMAN

Standardizing every article of manufacture and every commodity seems to be the order of the day. This not only applies to the iron and steel industry so far as its finished products are concerned, but to every article that enters into the manufacture of these products. The foundry is also sharing this tendency of the times, and to the writer has been assigned the problem of suggesting standards for the more common varieties of foundry facings in use today.

Most every foundry, whether producing large or small work must use sea coal or bituminous facing. This is a ground coal mixed with the sand to prevent it from fusing together and at the same time peel the casting.

This sea coal facing must be high in volatile matter, low in ash and sulphur. It must be known as a gas

*Presented at the Cincinnati convention of American Foundrymen's Association.



TABOR MFG. CO.
ARTHUR KOPPEL CO.; BROWN SPECIALTY CO.

DIAMOND CLAMP & FLASK CO.
HENRY E. PRIDMORE

coal, and the most suitable coal for this purpose should show approximately the following analysis: Moisture, 1.40 per cent; volatile matter, 37.66 per cent; fixed carbon, 54.44 per cent; ash, 5.86 per cent; sulphur, 0.64 per cent.

Not only should this coal show high in volatile matter and fixed carbon, but very low in ash and sulphur, but also this coal must be ground to practically the same consistency as the molding sand used for the castings.

In other words, for heavy work a rather coarse sand is used and the sea coal used for this purpose should all pass through a No. 14 mesh. For general or medium sized work, the sand of course being finer, it would require a finer ground sea coal facing, and this all to go through a No. 18 mesh.

For small castings such as stove plate and radiator work, naturally requiring a very fine and rather close sand, it requires a sea coal facing in accordance therewith, and all of this sea coal facing should pass through a No. 32 mesh.

There is also a sea coal facing which is termed "bolted," which is used for very fine ornamental castings requiring extremely sharp points. As this requires also a finely bolted sand in order to make a clean surface and not in any way disturb the face of the mold, it is necessary to have a bolted sea coal facing, which is practically of the same fineness as the molding sand.

Sea coal facing is used to mix with the sand to peel the castings, proportions running from 1 part of sea coal facing to 10 to 30 of sand, depending upon the size of the castings.

For what specific purpose sea coal facing is mixed with the sand, has not been fully determined, nor have our practical foundrymen or chemists given us any sufficiently satisfactory reasons why sea coal facing mixed with the sand will peel the casting.

In the writer's opinion, sea coal facing is mixed with the sand not only to prevent the sand from fusing, but also to vent the mold.

There has also been suggested that a good grade of sea coal facing with high percentage of volatile matter, when the hot iron comes in contact with the mold, forms a gas or cushion, so that the molten iron does not come in thorough contact with the molding sand.

As stated, this may be merely a theory, as it has not been absolutely determined what real action takes place when the molten metal comes in contact with the mold, and makes this separation.

Experiments.

In our experiments, we have molded brake shoes, using the same sands under the same conditions, mixing the sand 20 to 1 with the following: (1) sea coal, (2) Ceylon plumbago, (3) charcoal, (4) anthracite, (5) sawdust. All of these different materials were ground to the same fineness as sea coal facing. The only good castings produced where the iron did not burn into the sand, were from the molds made with sea coal facing. The Ceylon plumbago experiment indicates that it is not the separation of the sand particles by a medium preventing fusion. Sawdust contains more volatile matter than sea coal, but would not peel the casting. This disproves the cushion theory. The formation and following deposition of certain hydro-carbons, yielding carbon which peel the casting, may furnish a more plausible explanation.

This theory does not question or exclude the beneficial effect of sea coal as a venting medium, nor its influence in preventing a fusion of the sand by the separation of sand particles.

In making castings, especially me-

THE IRON TRADE REVIEW
OSCAR BARNETT STANDARD FLASKS
HOLLAND LINSEED OIL CO'S FAMOUS CORE OILS
WM SELLERS & CO
CENTRIFUGAL SAND MIXER

THE IRON TRADE REVIEW; THE FOUNDRY
OSCAR BARNETT FOUNDRY CO. WM. SELLERS & CO.; DETROIT TESTING LABORATORY
HOLLAND LINSEED OIL CO.

dium and large size, something is required to face the mold; that is, by facing the mold, I mean covering the pores of the sand, so that the mold will practically have a smooth surface.

The very best article for this purpose is plumbago or graphite with a high percentage of graphitic carbon. This plumbago must contain a certain percentage of graphitic carbon so that when the molten iron is poured into the mold, it will assist the iron to find its proper resting place, and be of such a refractory nature that the iron cannot cut into the mold itself.

A good plumbago or blacking must not only have the proper chemical analysis, be of such a refractory nature to withstand the hot iron from cutting into the mold, but also be of such a nature that it will not retard the flow of the molten metal but on the contrary, assist it to glide along.

From many years' experience it has been found that plumbago or graphite of a high graphitic carbon is the most suitable for this purpose, not only in dry sand, but in green sand work, and also for blacking cores.

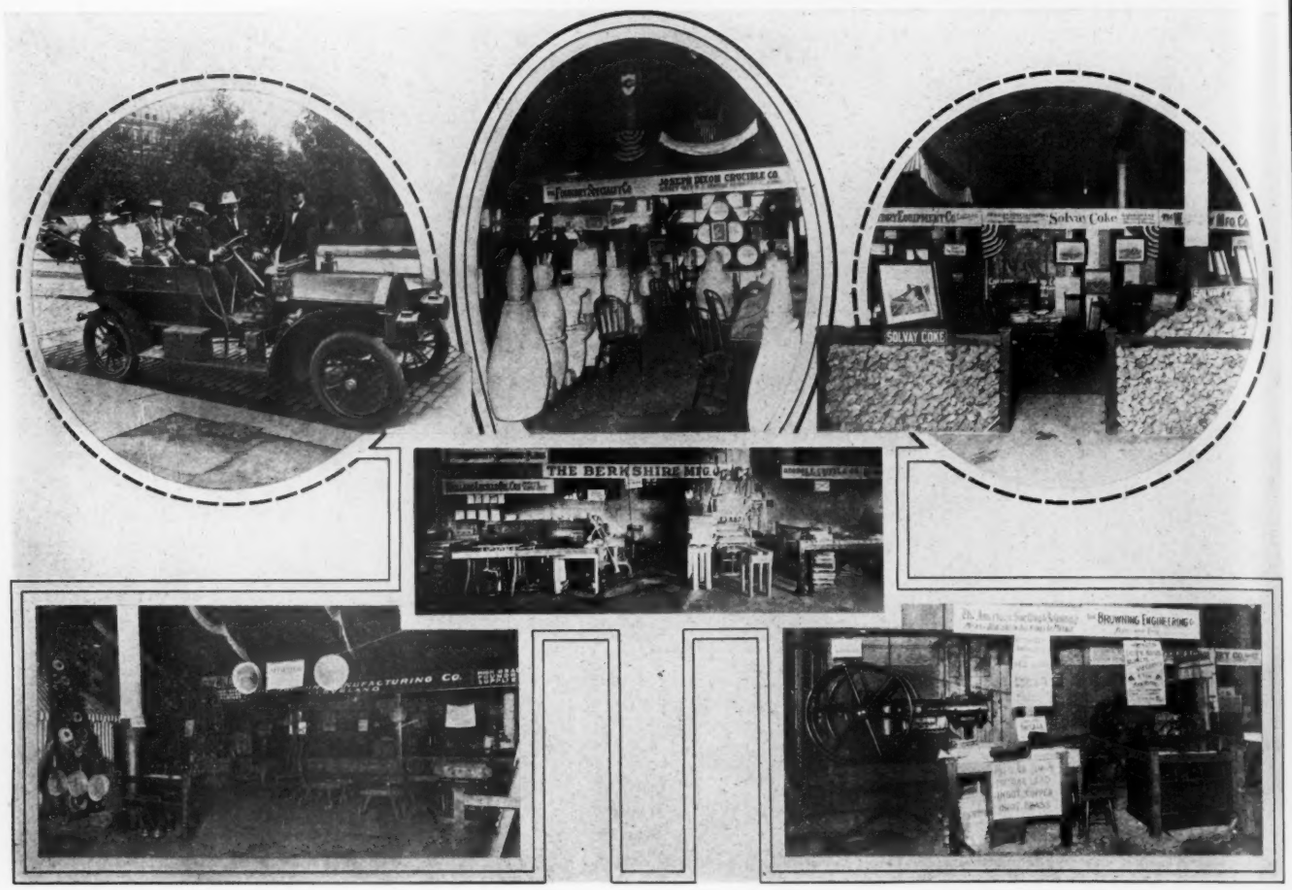
Ceylon graphite should analyze about as follows: Moisture, 1.20 per cent; oxide of iron, 5.90 per cent; aluminum, 3.06 per cent; lime, 0.90 per cent; silica, 16.14 per cent; graphitic carbon, 72.80 per cent.

The bulk of Ceylon graphite imported for foundry facings runs between 50 and 60 per cent graphitic carbon. These are straight Ceylon graphites, not touched by the facing man. In the face of this fact an amusing instance may be mentioned here. We had made a shipment of straight Ceylon graphite showing 62 per cent graphitic carbon to an eastern firm; their chemist was of the opinion that all Ceylon graphites analyzed 100 per cent graphitic carbon. With great care he figured out to the third decimal how much of an inferior article we had added to the Ceylon plumbago, and we "got it."

Relative to coke blacking used on certain classes of work, this should analyze: Fixed carbon, 88 per cent; ash, 9 per cent; sulphur, 0.8 per cent. Anthracite blacking when used as a pipe blacking or mineral facing should show: Moisture, 7 per cent; fixed carbon, 84 per cent; ash, 9 per cent; sulphur, 0.5 per cent.

A good grade of charcoal facing which is generally used by the foundries, not only for parting purposes, but also for foundry facing and as a core wash, should analyze: Volatile matter, 10 per cent; fixed carbon, 85.8 per cent; ash, 3.7 per cent. Ash varying according to the kind of wood and time of cutting.

The "Sly Pathfinder" is a new house organ published by the W. W. Sly Mfg. Co., Cleveland, manufacturer of cleaning room equipment, grinders, cinder mills, etc. It will hereafter be published on the fifteenth of each month and the May number in addition to several articles on foundry practice contains several contributions treating of the buying and selling of foundry supplies. It also contains several pages of well selected humorous matter.



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FOUNDRY USE OF PULVERIZED COAL*

BY RICHARD K. MEADE

THE USE of pulverized coal in place of producer gas and oil for heating furnaces of all classes has grown very largely during the last 10 years. At the present time, it is safe to say that approximately 2,500,000 tons of coal are burned annually in the pulverized condition. This form of fuel is used almost exclusively for the heating of rotary cement kilns and furnaces for the nodulizing of fine iron ores, the only exceptions being in localities where natural gas is available or where fuel oil is cheaper than coal. Powdered coal has also been used for the heating of furnaces for malleable castings and annealing.

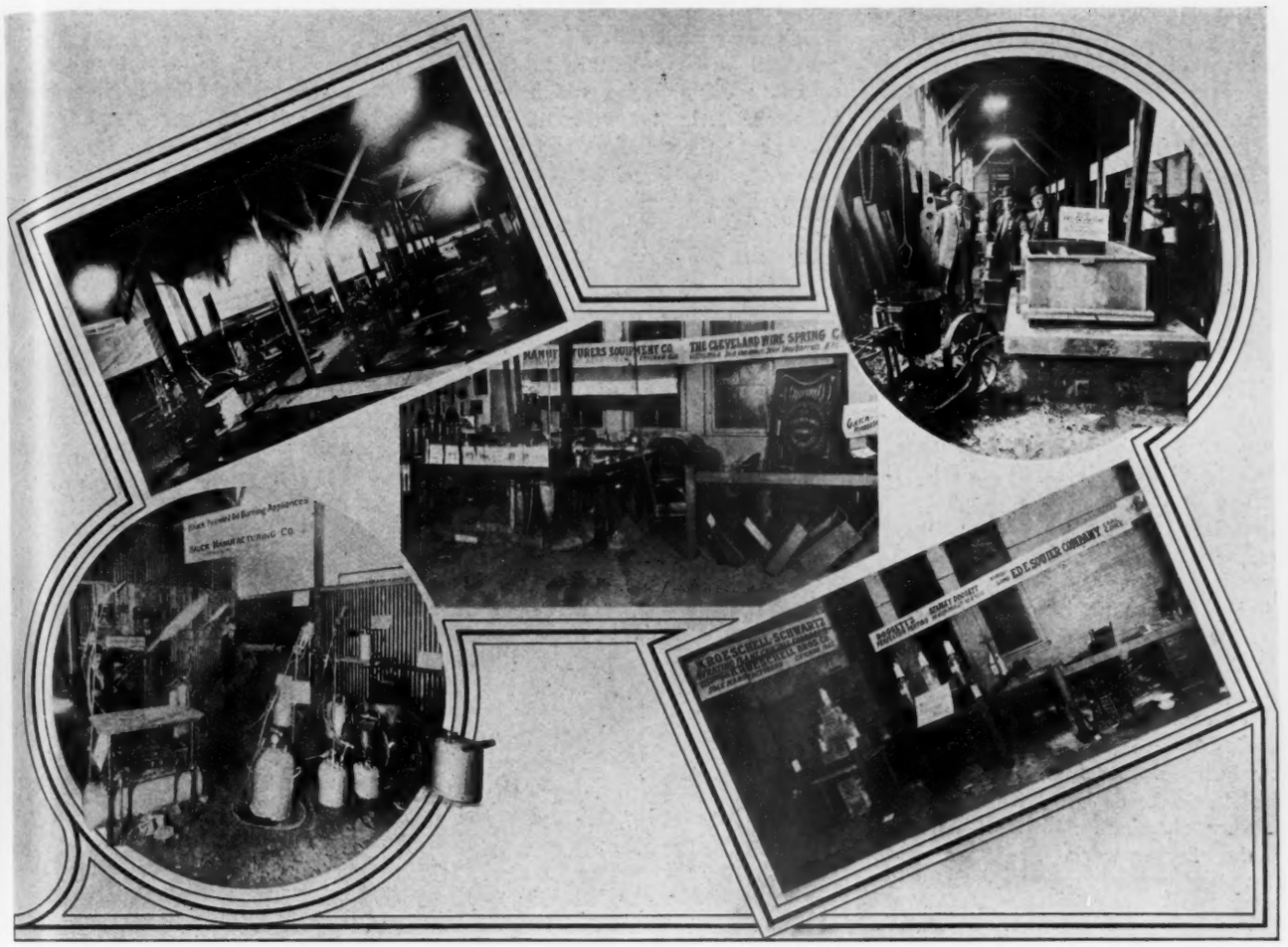
*Presented at the Cincinnati convention of American Foundrymen's Association.

The subject is one which has not received the attention from metallurgists and foundrymen which it deserves. The use of pulverized coal offers many advantages over gas heating, not the least of which is the economy. Where coal is converted into gas there is always a certain loss due to the complete combustion of a part of it to carbon dioxide and also to the fact that some heat is lost by radiation and some coal is carried away unburned by the ash. It has been estimated that the losses of the producer are seldom less than 20 per cent, and generally average about 30 per cent of the thermal value of the coal. Where pulverized coal is burned, on the other hand, the coal is injected into the furnace and is entirely burned in direct communication with the charge. The entire number of heat units in the coal is liberated in the furnace and consequently the whole amount of heat is produced where actually needed.

Advantages of Pulverized Coal.

Another advantage which is to be met with in the burning of the pulverized coal is in the fact that it may be burned with almost the exact theoretical quantity of air necessary for complete combustion. Frequent analyses made upon furnaces fired with pulverized coal show that the excess of air can be easily reduced to 20 per cent of the theoretical quantity without having more than 0.1 or 0.2 per cent carbon monoxide in the waste gas. If a reducing flame is desired it is easily possible by diminishing the quantity of air admitted, to produce a flame of the latter quality.

Coal dust heating is particularly well adapted to obtain high temperatures in open-hearths and furnaces of this



COOPER-HEWITT LIGHTS IN THE TEMPORARY BUILDING FURNISHED BY THE WESTINGHOUSE ELECTRIC & MFG. CO.

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character. It is possible by using powdered coal to obtain a very much higher temperature than can be done by the use of producer gas. For instance, with ordinary good gas slack it is easily possible to obtain a temperature of between 1,800 and 2,000 degrees Cent., while with producer gas without regeneration, it is seldom possible to obtain a temperature within 300 or 400 degrees of this.

It is also possible with powdered coal to obtain just as long a flame as can be obtained with producer gas. By varying the draft and consequently the amount of air brought in with the coal and the fineness of the latter, it is easily possible to draw the flame entirely through the furnace into the stack. We have even seen the brick of the stack slagged where the flame had been allowed to go the full length of the furnace. It is also possible to concentrate the flame within a very short zone. In a rotary cement kiln, 60 feet long, by the use of a damper consisting of a door at the foot of the kiln stack, it is possible to obtain a flame which will reach either the entire length of the kiln or else be concentrated in the first 20 feet.

With pulverized coal it is possible to obtain a very regular heat, much more regular than can possibly be done with producer gas. The latter is very irregular in its composition, even where the producers are very carefully handled, while with the coal the composition is usually very constant. If the coal is fed to the furnace at a uniform rate and the air admitted to the latter through an opening of definite area, the temperature will remain practically constant, other conditions remaining so.

Use of Low Grade Fuel.

Another advantage which is met with in pulverized coal firing is in the use of low grade fuels. Many coals may be burned in this manner, which would slag so badly if burned on a grate, that the producers or furnace would have to be entirely shut down to remove the clinkers. The accompanying table gives some analyses of coals which have been burned in the powdered form. As will be seen, most of these coals are high in volatile matter and these are best for pulverized firing. It is possible, however, to burn coals very much lower in volatile matter than those given in any of the above analyses by pulverizing the coal very finely.

Analyses of Coals Used for Burning in Powdered Form.

	Moisture, per cent.	Volatile, combustible matter, per cent.	Fixed carbon, per cent.	Ash, per cent.
Wellston, O.	2.94	41.96	42.82	12.27
Fairm't, W. Va.	1.38	35.04	56.03	6.27
Connellsville, Pa.	2.15	34.20	57.49	6.16
Illinois	7.50	30.70	53.80	8.00
Alabama	0.82	33.76	61.57	3.85
Hocking Valley	6.59	34.97	48.85	8.00
Poor quality, Pa.	2.10	29.63	51.28	16.99
Poor quality, Pa.	2.32	27.08	47.34	23.26

Another saving which is effected by the use of pulverized coal is in doing away with very tall stacks in order to provide draft sufficient to draw the air through the fuel bed. This draft is always more or less an uncertain quantity, owing to the fact that it

varies considerably with the nature of the coal used. With pulverized fuel, all that is needed is sufficient draft to carry off the products of combustion.

The three questions which are most frequently asked in connection with pulverized fuel are: What becomes of the ash? What is the danger of explosion? What is the cost of the process, both for installation and operating expenses?

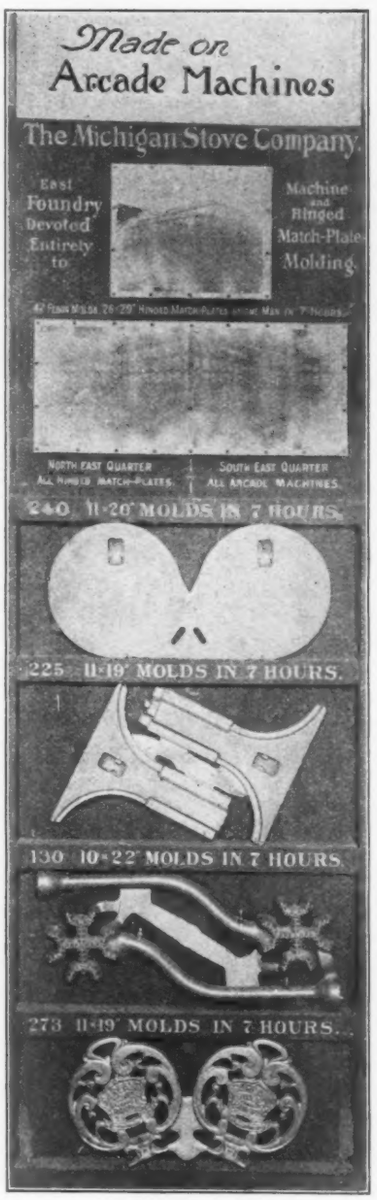
The Ash.

With respect to the first question, it may be said that the ash of pulverized coal is very light and that a great deal of it is carried off by the strong draft which exists in most metallurgical furnaces. There need never be any apprehension, however, that sufficient of the ash will settle on the charge to insulate it and prevent the heating of the latter. Where regenerator furnaces are used, however, to heat the air for combustion, the ash, of course, may collect in the checker work. Where pulverized fuel is used for burning, therefore, the regenerators should be designed with large ash settling chambers and wide passages in the checker work. The latter should also be so fixed that they may be cleaned out with a jet of compressed air. As we have said it is possible to obtain much higher temperatures with pulverized coal than can be done with producer gas, it is probable that in many instances the regenerative furnaces could be left out altogether and that pulverized coal would still show as good economy as producer gas. The amount of heat introduced by preheating the air necessary (10 pounds) for the combustion of 1 pound of coal is never more than 4,000 B. T. U., which just about balances the loss in the producers in gassifying 1 pound of coal.

Projecting the Flame.

It happens that if the flame is projected directly against the wall of the furnace that the ash will slag the latter and very soon eat it away. The best plan therefore in heating these furnaces is always to direct the flame so that it strikes against either the charge or else the slag upon this.

With respect to the second question, the danger of explosion, this has been very largely magnified. Pulverized coal in a pile burns very slowly and with absolutely no explosive effects. It is only where the coal is stirred up and suspended in the air that explosions occur. They also occur very much more frequently in badly ventilated buildings. To guard against explosions the building in which the coal is pulverized should be provided with ventilators in the roof to carry off any gas which accumulates. Electric lights should be used throughout the building, and no workman's torches should be allowed in it at any time, whether the mill is running or not. With a little precaution, firing with powdered coal may be considered as safe as firing either with producer gas or oil.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240 11-20" MOLDS IN 7 HOURS.
225 11-19" MOLDS IN 7 HOURS.
130 10-22" MOLDS IN 7 HOURS.
273 11-19" MOLDS IN 7 HOURS.

EXHIBIT OF MACHINE-MOLDED STOVE PLATE MADE BY THE MICHIGAN STOVE CO.

Cost of Grinding the Coal.

As to the cost of preparing the coal, a great many improvements have been made of late in grinding machinery, and materials of all classes may now be pulverized at a much lower cost than formerly. Where small quantities of coal only are needed, any of the wind pulverizers on the market will give fairly satisfactory results. Where quantities of coal, approximating 40 or 50 tons per day, are to be burned it will always be found more economical to install a good fuel plant. Such a plant would consist of a rotary cylindrical dryer through which the coal is passed to free it from its moisture. The dryer is followed by either a pot crusher or a set of rolls which are designed to reduce the coal to a size of ½ inch and under. The pot crusher may be followed by a Fuller-Lehigh mill. This mill is very economical of power and has a large output compared with the energy necessary to run it. These mills are practically dustless, take up small floor space, and are well suited to coal pulverizing. A mill of this type will grind from 150 to 200 pounds of coal per horsepower-hour, bringing the coal to a fineness of 92 per cent, passing a No. 100 mesh sieve.

The cost of a plant for preparing 100 tons of coal per day will be approximately $17,000. A plant for the production of one-half this quantity would cost about $10,000. As to the cost of preparing the coal itself, a plant preparing 100 tons of pulverized coal per day would cost about $30 per day for running expenses, labor, power, coal for drying, repairs, fixed charges, etc., which would make the cost of preparing the coal 30 cents per ton. This is a liberal figure.

Burning the Coal.

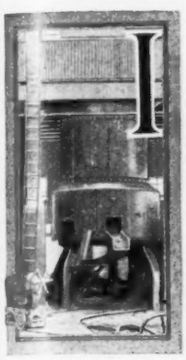
As to the method of burning the coal, this is usually done by means of a form of injector together with a fan. The coal itself is usually brought from the fuel mill by means of a screw conveyor and stored in a large bin near the furnace. It is drawn from this by means of a screw conveyor. This conveyor is actuated by some form of speed controller and the amount of coal fed to the furnace may be regulated very closely by the speed at which this screw conveyor is run.

As to the actual results obtained at various foundries, it is almost an impossibility to get any reliable figures. Even from several plants with the installation of whose grinding machinery the author of this paper has been intimately connected, it has been very hard for him to obtain any information. The conclusions drawn above, however, have been verified by the results obtained by one large foundry using powdered coal for firing its heating furnaces.

THE CONTINUOUS MELTING PROBLEM*

How it was satisfactorily solved---The sequence of operations includes the use of permanent molds

BY RICHARD H. PROBERT



IN THE continuous melting of iron in our foundry we operate two cupolas alternately. They are situated side by side, midway and at one end of the molding floors. They were made in our own shops and are of the same size and type. Their dimensions are as follows: Height over-all, 30 feet 6 inches; inside diameter, lined, 30 inches; size of charging door, 1 foot 6 inches by 2 feet 4 inches; five tuyeres, 4 inches by 5 inches each; air or blast box, 6 inches by 2 feet 4 inches; melting zone, 8 inches above the tuyeres and extends up for 20 inches; from the bottom to charging door, 9 feet; from the top of charging door to top of stack, 19 feet; from bottom to slagging hole, 12 inches; from bottom to tuyeres, 20 inches; outside diameter of stack, 42 inches; outside diameter from charging door to top of air or blast box, 56 inches; outside diameter from top of air or blast box to base, 68 inches.

The stack is lined with regular stock fire brick and from the charging door to the bottom is lined with cupola blocks 4 inches thick, 6 inches wide, 6⅞ inches inside radius and 9 inches outside radius. These blocks and the fire clay used with them are of the best make. They are guaranteed to withstand over 3,000 degrees Fahr., are dense, hard, tough and very refractory, made from flint clay, high in alumina. It is economy to use high grade material for lining from bottom to charging door, especially on continuous melting, as previously, the repairs were very considerable over and above what it now costs, in fact over double. The space between the shell and the lining is filled with grout. The last lining, from the charging door to the bottom, was put in on Nov. 2, 1907, and it is still in good condition.

*Presented jointly before the Ohio Society of Mechanical, Electrical and Steam Engineers and the Cincinnati Convention of the American Foundrymen's Association.

Cupola Charging.

In addition to our continuous melting we make gray iron castings for machine, structural and other lines of work, which are put up on the regular sand floor. These castings are poured each morning before the continuous work is begun. The night watchman lights the cupola at 6 o'clock, everything being in readiness the previous evening. The first iron is tapped out at 7:20 or 7:30 a. m. The first charge of coke to heat the cupolas and form the bed amounts to 500 pounds; we previously charged 900 pounds, but successfully reduced it to 500 pounds. Our charges are small in comparison to those of general foundry practice, but owing to the nature of the work and the continuous melting, the charging of the cupola and frequency of the tapping require careful adjustment to prevent loss.

Melting.

The charge consists of 100 pounds of coke and 500 pounds of iron, about as follows: 100 pounds of machinery scrap; 250 pounds of pig iron and 150 pounds of remelt. The last three coke charges are usually 50 pounds, 50 pounds and 25 pounds; limestone will average about 2¼ per cent of the total iron charged. On a day's run of 20 charges, lime rock is commenced with the fifth heat and stopped on the fifteenth. This has been closely followed and no difficulty is experienced. Loss in melting is about 2½ per cent deducting the finished castings and scrap from total iron charged. Slagging commences regularly on or about 11 a. m. each day.

Cupola Repairs.

We daub the cupola with swamp or blue clay mixed with fire-clay. The melting zone and bosh is repaired with one part swamp clay and two parts fire clay, with small crumbs of fire brick. Sand bottom is made from the siftings of the previous bottom, tempered with three shovels of new molding sand, slightly dampened and riddled. The bottom is stamped and rammed close with a close joint of fire clay around the edges. We make up the bottom as dry as possible, which is the best practice for small heats, as it does not chill the iron when first melted. The thickness is 3½ inches at the level of the tap hole and slopes to 4¾ inches thick at the back. This will give a slope of ½ inch to the foot. Figuring inside measurements, the slag hole is 8 inches above the sand bottom, from the slag hole to the bottom of tuyeres is 9 inches and from the top of tuyeres to the bottom of melting zone is 8 inches, with the melting zone extending up about 20 inches. The breast is made with a fire brick, chipped, grooved and beveled on the inside to 1 inch in thickness at the bottom side. The groove forms the tap hole. This brick is set in place with fire clay. The spout is lined with two fire bricks, end to end, and grooved or channeled out, fitted and daubed smooth with fire clay.

The blast pressure equals six ounces and is regulated with a swing valve. The wind intake is 10 inches by 10½ inches, which exceeds the tuyere area 5 square inches.

Coke.

All our coke is kept perfectly dry, being unloaded direct from the cars into storage bins built inside the foundry at the foot of runway to the cupola. The coke analysis follows:

	Per Cent.
Volatile matter	0.67
Fixed carbon	87.05
Ash	10.60
Sulphur	0.74
Phosphorus	0.016

Frame Running.

It is very important that the molding frames and molds be kept up to the highest state of efficiency so as not to cause delay in the pouring

and the holding back of the iron in the cupola. The frame and mold capacity should always be greater than the pouring capacity, which will permit of continuous work. The cupola tender must strictly watch his charges. He must not melt down too fast. The blast must be regulated so the heat is at all times fully known to him. He should keep in close touch with the work on the foundry floor and be ready to give or slack his metal as it is required by the men. Good common sense and strict attention to his duties are required to prevent chilled heats, overheating and other losses. Slagging commences regularly each day about 11 a. m. The slag is allowed to accumulate until just below the tuyeres. Our experience is that by leaving the slag to this height we get cleaner iron and better results from the blast. We open the slag hole just enough to let the slag run and by letting this gather in a crust on the outside of the slag hole, it acts as a trough and prevents the blast escaping with the slag.

Molding Frames.

The molding frames of the permanent molds are either square or rectangular in form but should always be carefully designed so the molds can be arranged on the frames to the best advantage for the work to be done. They can be made with flat bar iron, cross and intermediate bars fastened to the cast iron frame with solid cast iron trunnions on each side, or a framework of angle iron with cast iron trunnions bolted to the sides with flat bar iron cross pieces to the angle of the framework. This makes a much stronger frame. The molding frames are supported on cast iron stanchions set securely in an upright position in the molding floor, the top of each stanchion is made with an open bearing or journal fitted up to take in the trunnions on the ends of the molding frames. This allows the molding frames to revolve freely on the trunnions, as in operating a number of molds on one frame the pouring of the molten iron cannot always be done from the same side of the molds, the gates do not run in the same direction, consequently, some of the molds must be poured from the opposite side to the others. The revolving frames can be turned to the best position and quickly fastened in place with a plain steel pin set into holes drilled in the end of one of the trunnions, to a lug or bracket on the stanchion below the bearing. For some work, the molds on one side of the molding frame are much heavier and larger than those on the other side, which causes the frame to be top heavy and difficult to handle. This can be easily overcome by an arrangement of counterweights, adjusted so as to properly balance the frame. A circular, revolving molding frame is very convenient and can be worked to advantage on standard lines of duplicate work, in which the molds are self-contained and separate unto themselves. Such an arrangement would permit of the iron pourer getting around his work quickly besides leaving sufficient room for more than one man to pour iron on the job at the same time.

Permanent Molds.

Our permanent molds are largely ornamental, some of them are made to hinge and are provided with a swivel clamp set into a lug on the side of mold for fastening the two halves together. Others are not hinged and are fastened together with screw clamps or gib and key. Any arrangement made for the fastening of the mold together should be made so the same can be taken apart easily and quickly, as it is necessary to open up the molds as soon as poured, in fact while the casting is at a bright, red heat.

Castings that are unequally proportioned and uneven in their different parts will crack open and chip if allowed to cool in the molds. The molds are machined on the faces that close together so as to make a tight, even joint. They are also machined on the bottom side that is bolted to the molding frame. They are drilled and tapped with the hinge pin properly fitted, so it is necessary to have them soft enough to permit of this machine work and fitting being done and still be tough enough and of the right grade of iron to stand up to the molten metal continuously poured into them. If they fail to do this and burn out quickly, it is quite a loss of time and expense, including delay in producing the work and the expense of remaking the molds. After some experimenting the writer found that molds with the following analysis gave fair results:

Silicon, 2.15 per cent; sulphur, 0.086 per cent; phosphorus, 1.26 per cent; manganese, 0.41 per cent; com. carbon, 0.13 per cent; graphite, 3.17 per cent.

Molds made from iron with this analysis are worthless:

Silicon, 3.30 per cent; sulphur, 0.057 per cent; phosphorus, 0.67 per cent; manganese, 0.12 per cent; com. carbon, 0.19 per cent; graphite, 2.98 per cent.

Molds that gave the best results were made from two special brands of No. 2, foundry pig, their analyses marked Nos. 1 and 2; heavy machinery scrap and our regular No. 2 foundry pig.

Silicon, Per cent.	Sulphur, Per cent.	Phosphorus, Per cent.	Manganese, Per cent.
	No. 1, STRONG IRON.		
1.50 to 1.75	0.015 to 0.03	0.18 to 0.20	0.60 to 0.90
	No. 2, FLUID IRON.		
2.25 to 2.75	0.015 to 0.03	0.40	0.45

The charges were made up from:—

150	pounds of No. 1 (analysis No. 1)
75	pounds of No. 2 (analysis No. 2)
100	pounds of regular No. 2, foundry pig.
200	pounds of heavy machinery scrap.
525	pounds charge.

The analysis of the molds cast from this mixture follows: Silicon, 2.02 per cent; sulphur, 0.07 per cent; phosphorus, 0.89 per cent; manganese, 0.29 per cent; combined carbon, 0.84 per cent; graphite carbon, 2.76 per cent.

These cast molds are easily machined and do not burn for a reasonable length of time. Extra care is taken in molding them. We have success in using a molding sand made up from:

8	parts of old floor sand.
3	parts of new floor sand.
1	part of sea coal facing.
1½	parts of sharp sugar sand.

This, with plumbago, a good parting, together with careful melting by the cupola tender, has given us the best permanent molds.

High Carbon Steel Mixed with Molten Iron.

Iron was taken from the above charge, and 7 per cent of tool steel turnings—fine lathe turnings—were mixed in the ladle and well agitated before being poured. The cast, permanent molds from this are standing up well, but we have not yet had sufficient time to thoroughly test this mixture.

Quick Operation.

Continuous melting can be easily arranged for and with an equipment of overhead runways and hoists, the frames can be quickly changed. The molds on all frames can be previously made ready by the mold makers, so that very little time is lost in changing frames. It is advisable to have a few extra sets of stanchions for all preparatory work to be set up on them, thereby preventing delay.

A mixture of linseed oil and powdered soapstone, or oil and graphite, swabbed on the molds and gates each heat, will prevent the castings sticking and will prolong the life of the molds. The molds should be kept clean, and when not in use, stored away on shelves convenient to the molding frames. All our molds are classified and indexed in a mold book just as a well arranged pattern storage loft.

We use high carbon steel molds that have sharp, thin edges on their inside. In constant use, the steel in these molds becomes rough, but does not eat away and burn off as the cast iron molds.

By this process, with the proper mixture of metals carefully melted, and well-made permanent molds that will stand up to the work required of them, with instant effective pressure on the molds as soon as the molten metal is poured into them, cast specialties can be made with increased strength. The pressure will make them non-porous, more dense in structure, which the annealing would not weaken but rather toughen. Subjecting some cast specialties to pressure would make them more suitable for the finer line of machine parts, as they would be pressed into better shape, be cleaner, and with their parts more clearly defined. An equipment for such added pressure can be easily made, and after first cost would be a slight expense in operation.

THE PRACTICAL VALUE OF CHEMICAL STANDARDS FOR IRON CASTINGS*

BY JOHN J. PORTER

IN THE final analysis, the test of a successful foundry is its ability to make money for its owners, and the three factors which determine its success are: first, ability to make good castings; second, the ability to make good castings cheaply; third, ability to sell its product at fair prices. Since the composition of the metal going into the castings has a large influence on both the first and the second of these factors, we may perhaps be pardoned for again unearthing this ancient subject and may be permitted to consider it in its direct relationship to the commercial success of the foundry.

There are four factors on which the quality of a casting depends: the chemical composition; the treatment which the metal has received in melting; the heat treatment, that is, casting temperature and rate of cooling, and the perfection of the mold. These four factors are probably of nearly equal importance and each of them is deserving of far more systematic and extended study than has yet been given it.

Molding.

The cost of castings is not so greatly influenced by their composition and is perhaps chiefly a problem in the making of molds. In certain cases, however, it may play an important part, since the number of wasters or spoiled castings is often closely associated with the composition of the metal and, as all foundrymen know, there is nothing which will send the cost up so rapidly as a large percentage of bad castings.

The cost is also influenced by the chemical composition of the metal in another way, that is, by the cost of the iron used. This comes about from the fact that for any given casting there will be several different compositions, or perhaps a wide range in composition, any one of which is equally good. Some one of these, however, will be cheaper than the rest and hence the foundryman who works according to analysis and with full knowledge of his requirements in the way of composition, can effect a saving in cost which, though small, is not unimportant.

Use of High Silicon.

As an example of this, I would mention the case of the ordinary run of machine tool castings which are so commonly made in the foundries of Cincinnati. These castings are of medium thickness and must be soft enough to machine. Owing to the fact that the foundry is not commonly considered to have any rights that the machine shop is bound to respect, our foundry superintendents have had it most firmly impressed upon them that no crime is so heinous as that of turning out hard castings, and hence the custom has grown up of using from 0.25 to 0.50 per cent more silicon in these castings than is necessary in order to insure immunity from machine shop kicks. In other words, 2.25 to 2.50 per cent silicon is very frequently used in work where 2 per cent is quite sufficient. Now, if we examine the market reports of the price of pig iron, we find that there is an average difference of 50 cents per grade number per ton of pig iron; if No. 2 sells for $14.75, No. 1 will sell for $15.25. It is also a fact that the grade numbers represent a variation of 0.5 per cent of silicon, No. 2 averages 2.25 per cent, and No. 1, 2.75 per cent. Thus it may be said that each 0.01 per cent silicon costs 1 cent, and if we use 0.25 per cent more silicon than is necessary in our mix, we unnecessarily increase the cost of our metal just 25 cents per ton.

This may seem like a small thing, adding, as it does, only one-eightieth of a cent per pound to the cost of the castings, yet, when we consider that the excessive amount of silicon used has a very injurious effect in the way of producing dirty iron and porous places in the heavy sections, and thus is sometimes accountable for a considerable number of spoiled castings, the point does not seem so trivial.

Use of a High Percentage of Manganese.

Another case is found in the extensive use of manganese by some of our best informed managers who have learned to appreciate its excellent effects in giving clean, sound iron, and in reducing the scrap pile. One of my foundry friends tells me that by the use of high manganese pig iron he is enabled to use large amounts of very cheap high sulphur pig, the manganese counteracting the injurious effects of the sulphur and being itself comparatively inexpensive.

This same friend also says that he has not had a ton of No. 2 iron in his yard for months, his requirements being obtained by mixing a cheap, high silicon, high sulphur iron with other cheap, low silicon, high manganese irons. Of course, with this proceedure, very close attention to the details of charging and the meth-

*Presented at the Cincinnati convention of American Foundrymen's Association.

ods of receiving the iron in ladles is necessary, but the fact that it can be and is done successfully is worthy of careful attention.

Mixing by Analysis.

An erroneous idea, resulting from lack of confidence in the competency of mixing purely on the basis of chemical composition, is held by some foundrymen in the middle west. These men will tell you that it is very difficult to make satisfactory castings from northern or southern iron alone, but that a mixture of northern and southern brands is necessary for satisfactory results. No doubt this idea had its origin in the days when the grading of pig iron was done entirely by fracture. Southern pig iron averages high in silicon, sulphur and phosphorus. Northern iron averages low in these same elements. Hence by a mixture of these two, a happy medium was usually obtained. However, there are some brands of southern irons which are low in phosphorus, and which may be obtained with any desired silicon and sulphur, and by the use of these southern irons of correct composition just as good castings may be made as though a mixture of northern and southern iron giving the same composition were used. The advantage of this knowledge lies in the fact that southern iron can usually be obtained at a somewhat lower price than northern iron for corresponding grade numbers. At the present time the difference, in the Cincinnati market, is only 20 cents per ton as between northern and southern No. 2, but this difference is sometimes as high as $1.50 per ton, so that an important economy is open to the man who understands mixing by analysis and is not afraid to use the largest possible proportion of southern pig.

Many other examples might be cited showing the heavy penalty paid by some operators for their lack of knowledge of this subject, or lack of appreciation of its importance, and it is probable that there are but few plants where some improvement in cost or quality could not be made if all the information available were applied.

Metallurgy

This naturally brings us to the reason why our knowledge of foundry metallurgy is not more generally used since foundry operators are certainly not less enterprising or less desirous of economically conducting their business than we technical men who try to tell them how to do it. The answer to this question, may, I think, be found in the fact that the various data have not been gotten together in such form that the practical foundrymen can readily use them. It is well known that within recent years especially, vast additions have been made to our store of information regarding cast iron, but two facts militate against the use of most of it. The first of these is that but little of this material has been gathered together in handbooks or in such form as to be readily available for use. Most of it, and that the most valuable part, has been published in the various technical journals.

It is true that this scientific work is of the highest importance, indirectly, but it needs to be thoroughly digested, correlated with practical experience and the results restated in ordinary foundry language in order to make it available for practical use. There has also been done an enormous amount of technical experimental work which fails to be of value because of incompleteness, for example, data connecting the strength of iron with varying percentages of silicon are meaningless unless the percentages of other elements are also given. Moreover, statements that an iron of a given composition has such and such a strength is of very little use taken by itself since the value of a casting is seldom dependent upon strength alone and there are many other properties of cast iron, such as hardness, shrinkage, density, etc., which must also be considered.

Looking at it from this standpoint, it will be seen that the problem is very complex and not to be approached lightly. Some 20 different physical properties of cast iron may be enumerated which influence its value and adaptability for the manifold purposes for which castings are used. Cast iron may be regarded as an alloy of six elements—iron, carbon, silicon, sulphur, phosphorus and manganese—and since these elements may be combined in various ways, we may have some 12 or 15 different constituents. Now, since each separate constituent has or may have a specific effect on each of the 20 physical properties, it will be readily seen that if the problem is to be investigated systematically from start to finish an almost infinite amount of work will be required. To illustrate: if each of the six elements is varied in only seven proportions and each resulting metal tested for each of the 20 physical properties, 2,352,980 different experiments will be required. Evidently, then, any such review of the field as outlined here is entirely impossible at the present time.

As a matter of fact, such an accumulation of data would, after all, give us only half the information we require, since in a great many, perhaps the majority of cases, the exact physical properties which are necessary to make the best casting of any particular class are not well defined. For example, to take the case of a foundryman making hydraulic cylinders, even supposing that he had all this data at his command, it could not aid him unless he knew, also, exactly what degrees of hardness, strength, density, etc, are most desirable in his cylinder.

Evidently, then, the most feasible way of placing this metallurgical data before the foundryman in such form as to make it of practical value, is to first classify castings according to the physical properties which are of importance in them, and then to tabulate the chemical compositions which are found suitable for each class. It would also be highly desirable to take some cognizance of the factor of the cost of the mixture and show, where possible, how the foundryman could cut down the cost of his iron without decreasing the quality of his product.

An investigation carried out along these lines, while involving considerable work, would not be impossible and would certainly be of immediate and direct benefit to the foundry industry. The data needed could be obtained very largely from material already published and from inquiry among plants making the various lines of castings. Some experimental work would undoubtedly be needed to fill in the gaps, but I do not believe that it would be very great in amount.

With regard to the classification of castings, Thomas D. West has outlined a system of classification and divided castings into 34 classes.[1] I have not yet looked carefully into this phase of my subject and am therefore unable to say if this classification would be suitable for our purpose or whether a more or less detailed classification or a classification along different lines would be necessary.

In conclusion, it appears to me highly desirable that this subject be taken up by the American Foundrymen's Association and added to the number of those foundry matters which have been threshed out, systematized and standardized under our auspices.

[1] "Suggestions for Proceedure in Formulating Standards for General Castings." Transactions American Society for Testing Materials, 1903.

THE USE OF THE PERMANENT MOLD*

Discussion of the problems involved in the development of cast iron molds---Their successful use for making pipe and fittings

BY EDGAR ALLEN CUSTER

SOME 20 years ago the late Harris Tabor brought to the attention of the writer a machine for making brake-shoe molds. He was very enthusiastic over it, and predicted that in a very short time all the foundries would be making their duplicate work with that class of machine. He had worked at it long and earnestly, and believed that it would win instant recognition. He lived to see the molding machine field extending far beyond his wildest dreams, but it took 20 years!

To such an extent has this feature of the founding art grown that today we have molding machines, each of which costs more than the entire equipment of an ordinary foundry 30 years ago. The modern manufacturer is under the necessity of keeping down shop costs, and his constant endeavor is to substitute machines for manual labor where possible. It is this tendency that has of late years turned attention to the question of how far permanent molds may be used to reduce the cost of production. It is not a new question by any means, but the information available is very meager.

It is the purpose of this paper to give a full and free account of the conclusions formed after three years of constant work on the problem, and if it promotes a healthy discussion the main object has been attained. It must be understood, however, that this paper deals solely with work that is applicable to permanent molds, and the statements made, and the conclusions formed, are directed only toward that branch of the foundryman's art.

*Presented at the Cincinnati convention of American Foundrymen's Association.

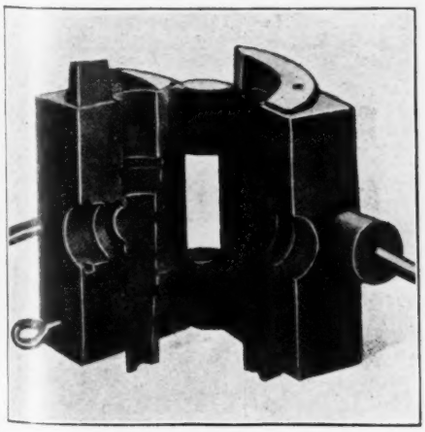


FIG. 1—A 2-INCH TEE MOLD IN USE FOR MORE THAN SEVEN MONTHS

Four Essential Points.

The subject may be taken up under the following heads:

(1) Of what material should the molds be made?

FIG. 2—CRACKS IN A GATE USED ON A PERMANENT MOLD

(2) What effect has such a mold upon the castings?

(3) What effect has molten iron upon the molds?

(4) What remedy should be applied for any bad effects shown?

These four points having been carefully considered, and the efficiency of such a mold conclusively demonstrated, the value of the permanent mold for certain classes of work is established.

The ideal material for a permanent mold would be one that would not chill the molten iron, would stand swift heating and cooling without disintegration and would be capable of being machined or molded into the shape required. This material should be very nearly as hard as iron, quick to conduct heat and of low specific gravity.

There are a number ot substances that fulfil these requirements in part. Lava rock will stand the sudden changes of heat and cold, can be cut into the shape desired and does not chill the molten iron. When a coating of finely ground mica, or some other inert substance, is rubbed into such a mold it will give beautiful castings. But it wears away rapidly, and soon needs renewal. Were it not for this fault it would very nearly solve the problem. We found it extremely difficult to handle and prepare this substance, and this led us to seek a material that would possess both hardness and ability to stand the heat changes. Cast iron has been the favorite medium, and so far, nothing has been brought forward that is so well adapted for foundry work. It has the advantage of being easily machined, and the added advantage that it is formed by a process with which we

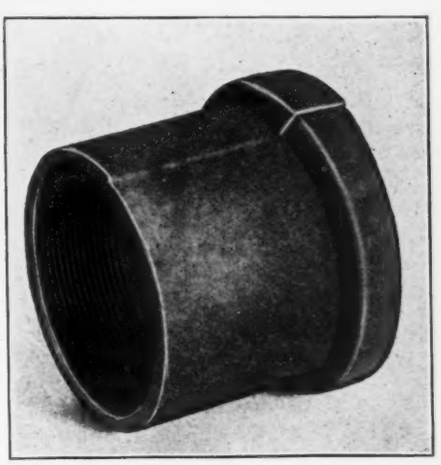


FIG. 3—THE THREAD IN THIS CASTING WAS CUT AND MICROMETERED

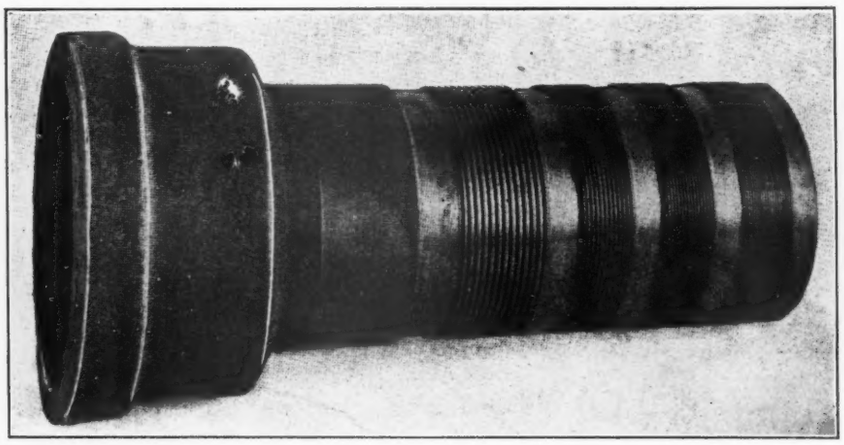


FIG. 4—SECTION OF PIPE ON WHICH THREADS HAVE BEEN CUT. THIS PIPE WAS NOT ANNEALED NOR TREATED IN ANY WAY. THREADS 8 TO 32 TO THE INCH

are all familiar, while its possible disadvantages are more easily overcome than those of any other substance.

The Iron Mold.

It is not much trouble to make and machine an iron mold, and we can calculate the expansion and contraction to a nicety. Its great drawback is its chilling effect. Some investigators make the claim that if the mold is heated to nearly the temperature of the casting when it is ready for removal, no chilling effect is perceptible; also that the molten iron should cool at the same rate in a permanent mold as it does in a sand mold. To both of these propositions I would answer that they defeat the object of permanent mold work, in that they destroy the permanence of the mold, confer no benefit on the finished product and set up a multitude of difficulties, such as core-crushing, shrinkage strains, and segregation.

But these two claims have been so persistently made that it seems advisable to treat them at some length. We are all familiar with the rapid disintegration of cast iron when kept at a very dull red heat—the rapid oxidization and the tendency to spawl and crack. When the heating and cooling is carried through a range of 200 or 300 degrees Fahr., and this must of necessity occur, the mold becomes useless in an incredibly short time. Again, the molten iron will not lay close to such a mold, and the resulting castings are far from perfect.

It has been conclusively demonstrated that mold distortions due to heat become permanent after a temperature of 900 degrees Fahr. has been passed, so that highly heated cast iron molds seem to be out of the question. While there is no doubt that they would prevent chilling, the cost of such a method would be prohibitive. Should the iron cool at the same rate in a permanent mold as it does in sand? The answer to this is most emphatically in the negative. The effect on the mold would be the same as maintaining it at a high heat, and the time lost in cooling would slow the process up materially. Slow cooling would not improve the casting, nor would it prevent segregation. It would induce shrinkage strains, and in fact would be no improvement over the present sand-casting method, except that it would obviate sand ramming.

Effect of Mold on Casting.

When we first contemplated using permanent molds it was considered a foregone conclusion that unless the interior of the mold was heavily coated with some inert substance, the casting would necessarily be chilled, and extensive arrangements were made to prevent or to remove this chill. For a time the molds were carefully coated after each pouring, but, in our efforts to gain time, this coating was neglected, and we noticed that even when this was the case no chill appeared, provided the casting was removed above a certain temperature. Following this lead we found that when the surface of the mold was practically free of any coating, no gases were formed by contact of the molten metal, and that chill could still be prevented by removing the casting at the proper temperature. Once these facts were thoroughly established, all our attention was centered on the possibility of removing the casting as soon as it was set. A few trials proved beyond doubt that molten cast iron does not chill until after the casting has set, and it was simply a question of reasonably quick work to produce castings not only perfect in form and texture but answering all the requirements for high-class marketable work.

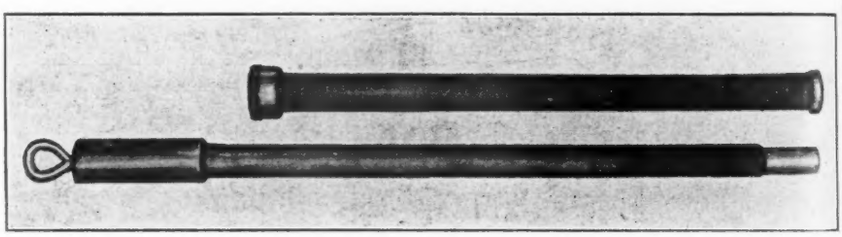


FIG. 5—A 4-INCH PIPE AND THE PERMANENT CORE USED FOR MOLDING THE SAME

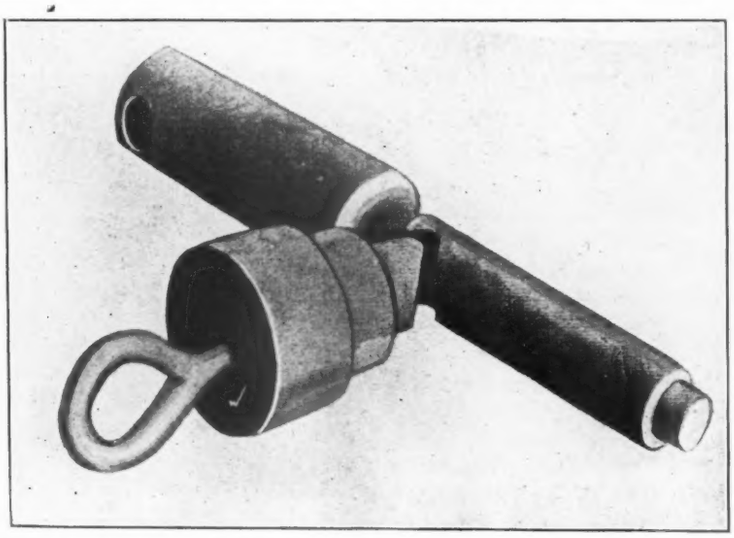


FIG. 6—ARBOR FOR A 2-INCH TEE IN DAILY USE FOR OVER SEVEN MONTHS

The next step in this line of reasoning was that if the contact with comparatively cold iron on one side, did not necessarily chill the casting, then contact with iron on both sides need not chill it. To demonstrate this point several thin sheets were cast between heavy plates and removed without chilling. This suggested the possibility of using metal cores, provided these could be removed before being caught by the shrinkage and immovably held, or the casting cracked. Reasoning that cast iron does not contract until after it is solid, we believed that it would be possible to remove a core before such contraction occurred. This was tried first on the T-shaped fitting, the entire core being made of cast iron, in two parts, one part for the main body and one part for the branch. These core parts were fitted to the mold and metal was poured around them, and it proved to be not only possible but very easy to withdraw the core, provided it was done when the casting was at the proper temperature. Nor was the allowable time for the withdrawal of the core so short as would be expected. In fact, it was necessary to wait a few seconds after pouring, before removing the core.

Iron Cores.

If, then, an iron core could be easily withdrawn from a tube 1 foot long, it was possible that it could be withdrawn from a tube 5 feet long. This was attempted, and repeatedly accomplished, a 4-inch pipe, 5 feet long being cast on an iron core and the core removed before being gripped by the contraction of the pipe. We found by these trials that no gases were formed other than those from the air in the mold, and if this air was allowed free vent no trouble was experienced in filling a mold of any shape or size, and in removing the resulting casting at such temperature as to avoid white chilled crystals.

Size and Shape of Mold.

The next step was to determine what size and shape of mold was best adapted to this process. This was a long and tedious investigation, most of the results obtained being of a negative character. It is almo t impossible to formulate any set rule as to size and shape of mold for various castings. The one general rule of allowing a surplus of metal in every case seems the best practice. This is, of course, very indefinite, and experience only will show what is best. The mold in which the traps are cast weighs 1,700 pounds, and the 2-inch tee mold confesses to over 500. The

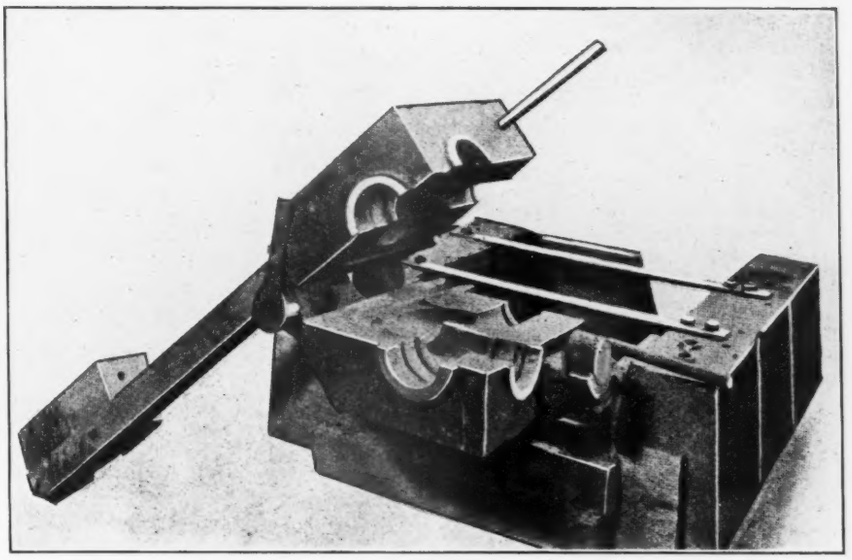


FIG. 7—A 4-INCH TEE MOLD. WEIGHT OF TRAP CASTING, 42 POUNDS

advantage of providing a large bulk of iron is too great to be ignored when it is considered that the objects desired are not only to swiftly remove the heat from the molten iron but also to provide enough metal to store this heat and resist the tremendous strains imposed.

Shrinkage.

It is to be observed that in using these molds we take no precautions against shinkage. We depend altogether upon the fact that chilling molten iron swiftly to the point of settling makes castings that are homogeneous, and thus the shrinkage strains, due to irregular cooling, are reduced to a minimum. The main object to be accomplished is to secure rigidity of the mold in all its parts, there is always time enough to remove the casting and retain the shape given it by the firm unyielding surface. A mold that has thin walls, 1½ or 2 inches thick, will spring away from the molten iron under the influence of the intense heat, and the casting will invariably follow the spring. Molten iron, like water, moves in the line of least resistance. Its peculiar property of increasing in bulk when passing from the molten to the solid state makes it possible to get a casting that fills every crack and cranny of the mold so long as this tendency to swell is successfully resisted. This same mass of iron in the mold, by reason of its rigidity and its capacity for quickly transmitting and storing heat, will greatly lessen the liability to cracks in the mold cavity. The only place where any deterioration

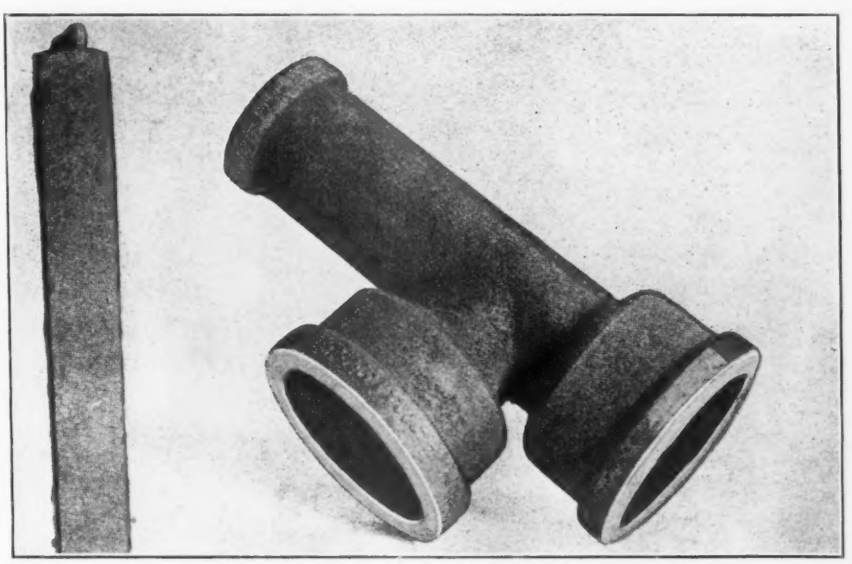


FIG. 8—EFFECT ON CASTING WHEN TAKEN FROM THE MOLD WITH THE INTERIOR STILL MOLTEN. GLOBULES OF IRON WERE FORMED ON THE SURFACE OF THE TEE AND THE IRREGULAR EXCRESCENCE FORMED AT THE TOP OF THE BAR

sets in is where the molten iron strikes in the gates, and our experience has shown that we can safely neglect this item.

Life of Cast Iron Mold.

How long a cast iron mold will last has not yet been determined. So far, we have made over 6,000 pieces in a single mold, and it is in better shape now than when we started. There is no reason why its life should not be indefinite, although there must be a point of time and service when the cast iron has reached its ultimate capacity for work. Our statistics show that the life of the mold depends, not upon the number of pourings but upon the number of times the mold is allowed to become entirely cold and then reheated. Continuous pouring, when correctly timed so as to preserve a generally even temperature, has but a very slight tendency to crack the mold. It is only when it is allowed to cool that the cracking becomes at all noticeable, and then only in the gates.

Temperature of the Mold.

We have found that a good casting can be made in a cold mold without any trouble, provided the mold is perfectly dry. But the tendency of the iron to condense moisture from the atmosphere while heating up is so great as to make it almost impossible to get a good casting unless the pouring is done rapidly, so that the mold will be filled before the moisture is deposited upon the face of the mold. In a perfectly dry atmosphere, with a cold mold, the iron pours readily and makes a very fine casting. The only reason it is desirable to have the molds warm is that they will then keep perfectly dry. We would much prefer to do all our work with a mold at a temperature of not more than 125 to 150 degrees Fahr. As a general rule the first casting is not a very good one, but after the casting has warmed up the mold, there is no further difficulty.

In order to preserve an even temperature in the mold it becomes necessary to put enough weight into it and pour the castings at such intervals that the temperature will not rise over a certain number of degrees. For instance, we found that casting a 4-inch pipe weighing 65 pounds into a mold weighing 6,500 pounds every seven minutes, does not raise the temperature of the mold to more than 300 degrees. This matter of heating depends altogether upon the thickness of the casting, and the molds must be designed with that particular point in mind.

That a permanent core can be used in a great many cases has been shown. The use of this permanent core is necessarily limited to castings in which the core is either in a straight line or is in a regular curve. Combinations of straight lines, such as in T's or Y's, or double T's or double Y's or straight pipes, are especially adapted to this feature. When the core is in the shape of a regular curve, or combination of a straight line and regular curve, it can be made in two or more pieces and easily withdrawn from the casting. This can be done in the case of L's, or sweeps. Irregular curves or cores that would be destroyed in removing them from the castings are, of course, not possible.

Metal for Cores.

We have found that the best metal for these cores is ordinary cast iron, and that the same method of procedure must be carried out for the core as with the mold. There is plenty of time to remove the core and open the mold and yet have the casting without any hard spots. The use of permanent cores suggests the possibility of a machine for duplicate work that is to be made in large quantities, and this machine can be practically automatic in its operation. Pipe fittings, chain links, elevator buckets might possibly come under this class. This is, perhaps, looking rather far into the future, but it is the logical outcome of the successful carrying out of the principle involved.

It has been found easy to remove a 5-foot core in the manufacture of cast iron soil pipe. It should be just as possible to remove a 12-foot core from a water pipe. It is only a question of apparatus large and powerful enough, and removing at the proper speed. Cores made of steel and wrought iron have been tried, but give very poor results. The cast iron cores require considerable attention for the first few pourings, to prevent burning and distortion, but after a few castings have been made the iron seems to become seasoned, and after 50 or 100 castings have been poured, very little care need be taken in regard to overheating the arbor or burning it by the impact of molten iron.

Soft cast iron seems to be the best medium for both molds and cores. It cracks less, and is not liable to distort, as is the case with a casting made of low silicon or very close iron. It may be that this is due to the fact that a high silicon iron melts at a much higher temperature than iron containing a low percentage of silicon, and consequently requires a higher temperature to reach the point at which it softens.

The conclusions arrived at as the result of these investigations may be summarized as follows: Any casting that can be poured in a sand mold can be poured in an iron mold. If the iron is hot enough to run in a green sand mold it will surely run in an iron mold. Iron that is suitable for radiators or fittings, or brake shoes, or any other class of duplicate work that is made in the sand, will be suitable for the use of permanent molds. The same experience that shows the foundryman what is best for sand molding can be utilized in permanent mold work. It is true that a somewhat wider range of iron can be used in permanent molds for the same class of work than is the case in sand molding, but any change from the general practice in selecting irons for any particular class of work must be made with a great deal of care. It is, of course, a subject that demands close and incessant study, and every manufacturer who wishes to use permanent molds must give the same care and thought to his method that he gave to previous methods employed. When the high-class engineering and technical skill is applied to the permanent mold that has been devoted to the molding machines now in use, we may expect to see some very wonderful developments in the foundry line.

Temperature of the Iron.

There is one more feature that has not yet been touched upon, and that is the temperature of the molten iron. In all cases, when using permanent molds, the iron as it comes from the cupola should be very hot, and should never be allowed to stand any length of time before pouring. The first element it loses in cooling is carbon, especially if there is considerable silicon in the original charge. Iron at 2,100 degrees, Fahr., with 2.5 per cent silicon, will not hold as much carbon in solution as it will at 2,400 degrees, Fahr., and it is the carbon we wish to preserve. In fact, it is almost impossible to make a very thin casting in an iron mold, with iron containing 2.75 per cent silicon and low in phosphorus and sulphur, unless the iron is very hot. Our work has shown us conclusively that the best results are obtained with iron containing over 3 per cent carbon and about 2 per cent silicon. Again, the higher the temperature of the initial iron, the more time there is for the removal of the casting, and the longer shrinkage is

delayed. The importance of hot iron is therefore evident, although there is but little loss of carbon when the silicon does not exceed 2.25 per cent, and ordinary diligence is used in pouring.

Coating the Molds.

Some care must be exercised to prevent the casting sticking in the mold. It is sufficient to coat the mold occasionally with a mixture of thin oil and graphite. There is no virtue in any of the many coatings recommended other than keeping the molds smooth and preventing the castings from sticking. None will prevent chilling, unless laid on in such quantities as to form a substantial wall of inert material. The writer has used almost every available substance in an infinite number of mixtures, with but indifferent results. Mica, lithophone, clay, graphite, molasses water and clay, paraffine with any number of materials, have been tried, but one and all require a coating at each cast, which is out of the question in rapid work. A thin solution of wood alcohol and shellac, thickened with finely-ground clay, when applied to a slightly warm mold, will usually prevent chill, but here again the mold must be cleaned and recoated for each casting. Silicate of soda, when fused to the mold has but a very short life, and amorphous phosphorus has an entirely undeserved reputation in the line of chill prevention. The best way to prevent a chill is to take the casting away from the mold before the chill sets in.

That this chilling does not take place until after the iron has been set sufficiently to handle is demonstrated by a small sample casting made especially for the purpose. One side of this casting is soft and the other is chilled. The quality of the iron in the unchilled portion is of the highest character. This sudden chilling to the point at which the molten iron sets, produces an iron that is as nearly homogeneous as it is possible to obtain.

Contraction and Expansion.

Now, what peculiar molecular action is set up that produces this result in an iron that when cast in sand exhibits all the defects we are accustomed to see in sand molding? To get at this explanation we must begin with the great unmeasureable force of heat contraction and expansion. No one knows how many tons per square inch is exerted when molten iron cools. This force is always greater than the tensile strength of the material under treatment. If, now, molten iron be subjected to this enormous force exerted through the mold, swiftly robbing it of its heat, it probably follows that the molecules are crushed together with an enormous pressure, and since this action is a matter of a few seconds at the most, there is no chance for segregation, and the impurities remain in the same relative position in the casting that they occupied in the molten iron. That this peculiar action continues after the casting has been taken from the mold is indicated by the small globules of iron that have been squeezed from castings as they cooled.

Now, let us go a step further. It has been found that iron when cast in an iron mold and removed as soon as it sets, possesses some unusual properties. For one thing, it will take a temper, and when tempered will retain magnetism. If the casting be taken from the mold at a bright red heat and suddenly quenched in cold water, it has all the cutting power of a good, high carbon steel. This result is invariably obtained whether the iron be high or low in silicon, phosphorus, sulphur or manganese. There is no evidence of what we generally speak of as "chill"—no white crystals are shown; in fact, an iron that chills white first in the mold and is then quenched in water will not harden in the manner described, but will crumble when applied to the emery wheel.

New Metal.

The fact of the matter is simply that chilling molten iron swiftly to the point of setting, and then allowing it to cool gradually, produces a metal that is entirely new to the art. It has all the chemical characteristics of cast iron, with the exception of combined carbon, and it also possesses some of the properties of high carbon steel. We have been taught that steel will not take a temper when it contains a very appreciable amount of free carbon, yet a piece of cast iron that has 0.44 per cent combined, and over 2 per cent free carbon, has been tempered repeatedly and will do better service in a lathe than a very good, non-alloy steel. Once this peculiar property is imparted to the casting, it is impossible to eliminate it except by remelting. A bar of iron so treated can be held in a flame until the metal drips from the end, and yet quenching will restore it to its original hardness. The analysis of the piece of treated iron referred to is as follows: Silicon, 2.28 per cent; phosphorus, 1.21 per cent; sulphur, 0.108 per cent; manganese, 0.41 per cent; total carbon, 2.65 per cent; combined carbon, 0.44 per cent.

An analysis of another piece shows: Silicon, 2.24 per cent; phosphorus, 1.12 per cent; sulphur, 1.01 per cent; manganese, 0.38 per cent; total carbon, 3.02 per cent; combined carbon, 1.54 per cent.

It will be noticed that the carbon for the first piece is low—much lower than we like to have it for our general work. But the remarkable feature about this particular phase of the process is that such a close-grained, tough and strong iron should be produced with an analysis such as given above. The analysis of this iron taken after it is removed from the mold, and without quenching, is the same as above, except that the combined carbon is not over 0.28 per cent.

The character of the iron before being quenched is very fine, close-grained and yet it is easily machined. In all this work there are no blowholes, and any dirt that enters into the piece must come from the ladle.

Effect of Carbon.

In some of our earlier writings the effect of the carbon in cast iron was exhaustively treated; in order to make clear the chemical changes that occur in this process, it may be well to repeat some of the conclusions.

All the carbon in molten iron is in solution, and exists in the combined form. Now, if molten iron be instantly cooled to 1,000 degrees, Fahr., all the carbon will be held in the combined form—there will be no free carbon. If, however, it be instantly cooled to the point at which the iron sets, and then allowed to cool normally, the carbon will be in the combined form at the time of setting, but will change to the free form as the cooling progresses. This formation of free carbon is very rapid. the major portion present in the casting is formed within a few seconds after it is taken from the mold. The analyses below give a very fair idea of this action, the pieces in question being 6 x 1¼ x ½ inches:

	Combined Carbon, Per cent.	Total Carbon, Per cent.
Cast in sand and cooled normally	0.27	3.20
Taken from permanent mold at bright yellow and quenched	1.50	3.02
Taken from permanent mold at bright red and quenched	0.49	3.10

It will be seen from this that two-thirds of the combined carbon has been changed in the few seconds required to cool from a bright yellow to the bright red. The free carbon in all these castings is not in the form of graphitic carbon, as we usually see it in ordinary cast iron, but partakes more of the character of annealing carbon. It is probably this annealing carbon that gives permanent mold castings their unsual strength and toughness.

The difficulties that confront an investigator who attempts to look into

the manufacture of castings are so great, owing to the peculiar conditions that surround the art, that much of the information that has heretofore been given is of value only when the local conditions are fully known. Our present-day technical journals, with their earnest and persistent work, have gone far towards making the foundryman's art a scientific process; but, after all, the sum total of all these efforts has been to seek a remedy for the difficulties encountered, in a process that in itself must of necessity often give unsatisfactory results. Sand as a medium for making general castings will always hold its own. We have discovered nothing that is so cheap and so efficient, considering the vast range of work it is required to do. Its deficiencies are well known; but so far, all efforts to overcome these deficiencies have been solely in the direction of shedding light upon the characteristics of the iron used. We read a great deal about the evils of sulphur and of phosphorus, and we find that these evils are not exaggerated when it comes to making castings in sand. But to my mind, the reason why phosphorus and sulphur are the bane of the foundryman's existence is not because of the mere fact that sulphur and phosphorus are present in the casting, but because in slow cooling in sand molds, sulphur and phosphorus segregate. Therefore, the great evil in cast iron work is not so much the presence of impurities, but the fact that segregation allows these impurities to mass themselves and thus destroy the homogeneity of the iron.

Our experiments have shown that an iron containing 1½ per cent phosphorus when cast in an iron mold is as strong as iron containing 4 per cent when cast in the same mold. We can find no perceptible difference in the tensile strength under these circumstances. The same is true with sulphur at 0.1 and sulphur at 0.03, and it would seem, therefore, that the mere fact of the presence of sulphur and phosphorus in these irons is not deleterious when segregation is prevented.

It is not within the province of the sand mold to prevent segregation, and the remedy can not be looked for from that point; nor is it possible to prevent a certain amount of segregation in a permanent mold when the casting is so thick in section as to make the cooling comparatively slow. Fortunately, most of the duplicate work in this country to which the permanent mold is applicable is comparatively small section—very little of it is more than 1 inch or 1½ inches in the thickest part, and when a casting is not thicker than the figures given above, and is made in a mold properly designed, there will be absolutely no segregation.

The formation and segregation of graphitic carbon is familiar to all; and its weakening effect upon cast iron is very well known. The casting made as above described, and containing free carbon that is thoroughly distributed throughout every portion of the iron and is not allowed to collect in large flakes or bunches, will be as easily machined and will have greater tensile and crushing strength than a casting made in a sand mold in the ordinary way.

The position the writer takes in this matter is that the evils of phosphorus and sulphur are due, not to the fact that these elements are present in the casting, but to the fact that the slow cooling allows them to collect in masses. If segregation were prevented a high phosphorus or a comparatively high sulphur casting would be just as strong as if these elements were low in percentage.

So far, we have discussed simply the use of the permanent mold as applied to the foundryman's art, with iron taken from the cupola. If, then, permanent molds can be used with success in the foundry, and a system of continuous pouring be inaugurated which in duplicate work would obviate the necessity of having molders, why is it necessary to melt pig iron in the cupola? What could be more ideal than a series of permanent molds supplied with molten iron practically direct from the blast furnace? The interposition of a reheating ladle such as is used by the steel makers of today, presents no unusual features; and this ladle makes possible the treatment of the molten iron. Modern practice has eliminated much of the uncertainty in blast furnace work, and it is not unusual to find these furnaces so equipped as to produce an iron that varies but few points from the quality desired by the foundryman. The molten iron we get from the blast furnace is much hotter than that obtained from the cupola, so that there is every reason to believe that the castings we would obtain would be of a better quality than when the pig is remelted in the cupola.

In our work we have conclusively demonstrated that it is immaterial whether an iron contains 1.75 or 3 per cent silicon, so long as the molten mass is at the proper temperature, so that the high temperatures obtained from the blast furnace would go far toward offsetting the variations in the impurities. Given, therefore, a furnace properly equipped and properly handled, with the interposition of a reheating ladle, there is no reason why a very high class of work should not be obtained with the use of permanent molds. How far this thought can be carried out lies with the blast furnace owner.

MELTING BRASS TURNINGS IN THE OIL FURNACE*

BY EDWARD H. McVEEN

FOR the past 23 years I have been melting brass, 20 years with the coke furnace, three years with the oil furnace. The three years' experience melting with the oil furnace, brass turnings from automatic machines will be the subject of this article.

The turnings are from the yellow brass stock rods made by the best mills in the country, their composition averaging about 60 per cent copper, 36 per cent spelter and 4 per cent lead. From these turnings we produce light ornamental yellow brass castings and some medium heavy plain castings for turning. These castings must all be sound, clean and smooth, the accomplishment of which is quite a trick as every foundryman knows.

We are using a stationary oil furnace that takes two No. 30 crucibles in the one chamber, using an air pressure of seven pounds and consuming three gallons of fuel oil to 100 pounds of brass melted, with a loss of 3 per cent in metal, crucibles averaging from 20 to 25 heats. Two hours' time is consumed in melting 200 pounds of metal, 30 pounds being gates and sprues, the balance turnings; the first heat from a cold furnace taking about one hour longer.

*Presented at the Cincinnati convention of the American Brass Founders' Association.

raw material—turnings, with a low market value.

In the oil furnace, we have the heat and blast under perfect control. This is of great value in feeding the furnace. Very often it is necessary to shut off the blast and oil to prevent the loss of fine particles of brass, flux or charcoal.

In bringing down a melt, I put in crucibles about 10 pounds of sprues or gates, fill on top with turnings, using about 1 ounce of rock salt for flux, covering the whole with about 2 inches of fine charcoal. I start the blast at about 4 pounds pressure so as to bring the heat up gently, as a cold furnace and crucibles will cause both to scale and possibly fracture. In 10 or 15 minutes I increase the pressure and in 30 minutes I have a melting heat. From this time on the furnace requires the attention of the melter.

With an iron bar I find that the metal and charcoal are quite a solid cake, but I know that in the bottom of the crucible there is a nice puddle of metal and I break down this crust with the bar and force it through the liquid metal and I then find I have room for about 10 pounds of turnings. These are fed into the crucible and in a few minutes, giving time to consume the oil that is in the turnings, the same process of breaking down and forcing through to the liquid metal is performed. This operation is repeated, using a little flux and charcoal until the crucible is full.

The oil and air pressure are gaged so that a rich sun colored blaze fills the furnace and a green yellow cone-shaped flame shoots 10 or 12 inches out of the top of the furnace. In a very short time one can recognize the zinc smoke, a positive indication that the heat is coming. I am not satisfied however with smoke alone, I must see the color of the metal, and note its clear liquid brightness before I tap vigorously on the iron tank for my helpers to handle the heat.

At times I have a little trouble with castings being rough and porous. In this case I increase the sprues and use less turnings, and for very particular castings, we use all sprues and gates or ingot metal from turnings. The melting of turnings to ingots and then remelting makes a wonderful difference in the castings produced, but is expensive.

Oscar H. Marschuetz, Louisville, Ky., superintendent of the Ahrens & Ott plant of the Standard Sanitary Mfg. Co., died at Cincinnati, May 19, where he was attending the convention of the American Foundrymen's Association. He had been with the Louisville plant for 22 years, and for the past few years had been a director of the Standard Sanitary Mfg. Co. Mr. Marschuetz was 55 years old and was born in Bremen, Germany.

BRONZE TABLET FOR FORT McHENRY.

The cast bronze tablet shown in the accompanying illustration was made by John Williams, Inc., New York city, for the United States government, and will be erected at Fort McHenry, Md. The design was furnished by Francis B. Wheaton, advisory architect, Quartermaster General's office, New York city. The tablet is 5 feet high and 3 feet, 3 inches wide. It was cast in United States standard bronze and is a highly finished piece of work.

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BRONZE TABLET FOR FORT McHENRY

WASTE HEAT.*

By F. W. Reidenbach

Do we, as foundrymen, get all the value from the combustible materials we use in melting the various metals? Or do we just melt metals? It seems to me we ought to utilize this waste heat to good advantage. Open-hearth steel mills, by the use of waste heat units, generate steam sufficient to operate large plants. Why not brass foundries? Construction of plant, would, perhaps, be the first consideration. A plant would have to be constructed upon lines whereby all of the valuable points appertaining to the use of the waste heat could come in for consideration. I would suggest a core oven as one important factor; a suitable rack for skin-drying molds would be another; or, like the steel mills, a steam plant sufficient to operate a tumbling barrel, a sprue cutter, a saw or emery wheels; or one may at least use the heat for producing hot water. That would add to the comforts of the help in washing up after their daily toil.

There are a large number of foundries which are today using special oil burning furnaces and forcing a tremendous amount of waste heat up through a tube to the outer roof. This waste heat could be made to do some work.

Many things can be accomplished with waste heat if proper attention be given to construction and the proper laying out of the foundry. Of course it would work more advantageously in the larger plants, but in this present age it seems to me that there is nothing impossible.

In the presentation of this paper the writer does so with the full knowledge that waste heat is a very important factor in the larger plants. In our works we maintain a steam-heating plant caring for our entire offices with the waste heat of only two, No. 200 crucible furnaces, at an annual saving of $300 in fuel.

*From a paper presented at the Cincinnati convention of the American Brass Founders' Association.

H. M. LANE ACQUITTED.

Henry M. Lane was placed on trial in the common pleas court of Cuyahoga county at Cleveland on May 17, Judge Vickery presiding, on a charge of taking zinc, half-tone and wax cuts from the Penton Publishing Co., which it was alleged had been carried away before his connection with that concern was terminated in January, 1907.

After a part of the testimony for the state had been heard, the prosecuting attorney remarked that it was evident that the defendant had not been properly indicted. Judge Vickery concurred in this opinion, stating that if any crime had been committed, it was embezzlement and not larceny, as charged in the indictment. He added that the evidence submitted was not strong enough to convict on the charge of embezzlement; hence he instructed the jury to return a verdict of not guilty, which was accordingly done and the defendant discharged.

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Foundrymen's Convention at Cincinnati

The constantly growing interest in the annual foundrymen's meetings was reflected by the large attendance in Cincinnati. While approximately 2,000 were registered, several hundred were present who failed to have their names enrolled. It is doubtful if any other educational body can show a similar record and is indicative of the magnitude of the foundry trade, placing it in the front rank of the great industries of the country. Throughout the entire week the exposition hall was crowded with foundrymen who came "to be shown," and that the requirements of many were satisfactorily met was indicated by the large number of orders placed with the manufacturers of supplies and equipment. The builders of machine tools, many of whom had never before attended these shows, were surprised to learn of the progress that had been made in the use of mechanical appliances in casting plants, and owing to the close relationship existing between the foundry and the machine shop, have determined to make exhibits next year. The progress in machine molding, exemplified by the large number of new devices shown, was a revelation to the large majority of foundrymen, and the advances in the other branches of the art as indicated by the displays, compares favorably with those of machine molding. The sessions of the American Foundrymen's Association and the Brass Founders were well attended, and the discussions developed many points of interest not touched upon in the papers. The joint meetings of these organizations was an innovation that should be followed at future conventions. The iron and steel and the brass founders have much in common, and the joint sessions afforded the members of the one society an opportunity to hear the papers and discussions of the other. Unfortunately, the proposal to increase the dues of the American Foundrymen's Association failed to carry, but those who have borne many of the burdens of the organization in the past hope that it will be favorably acted upon when again submitted. At present the dues are only sufficient to defray running expenses and salaries, and there is no fund that can be drawn upon for experiments and research work that should be conducted by a society of this kind. There is no lack of enthusiasm on the part of those who have worked earnestly to extend the scope of the society, but the handicap of insufficient financial support has retarded much work that would otherwise have been done. By far the most important action taken at this meeting was the adoption of standard specifications for foundry iron. For more than a year these have been discussed by producers and consumers and it is believed that they adequately cover the requirements of both. The appointment of a committee by the American Brass Founders' Association to co-operate with representatives of the American Chemical Society and the United States bureau of standards in the compilation of standard methods of analysis for brass and kindred alloys was by far the most important work accomplished by this organization. An earnest effort should also be made to standardize the large number of commercial mixtures in use today. These can be safely reduced and will, to a large extent, obviate many misunderstandings arising from the large number of specifications extant in the brass industry. The practical value of chemical standards for iron castings was emphasized in an able address delivered during this meeting, and the appointment of a committee for making a detailed classification of castings will aid the iron founders materially in their work. The local committee is to be congratulated upon its good work in amply providing for the welfare of the visitors. The entertainment was lavish and the hospitality of the Queen City was enjoyed and appreciated by all who attended.

LIMESTONE AS A CUPOLA FLUX.

To the Editor:—

In an article entitled "Limestone as a Cupola Flux," published in the May number of THE FOUNDRY, Mr. Keep objects to a limestone containing magnesia. The analysis given shows a very good magnesian limestone and it should make a good flux. Such a limestone has been used for years in blast furnaces and I see no reason why it could not be used in the cupola. The total silicates of lime and magnesia make a very fusible cinder. Mr. Keep says: "The lime is the only part of the stone that does any good and in addition you are compelled to melt the other 59 per cent which does not assist you in removing the impurities."

On the other hand, the same thing can be said of ordinary limestone. If a good limestone were used you would still lose 49 per cent, as you will seldom get over 51 per cent of available lime. This 49 per cent is

not a solid which is melted in the charge, but it is a gas, CO_2, driven off as the limestone becomes hot in the cupola. In the magnesian limestone you have just the same loss in gas, but the 40 per cent lime and 12 per cent magnesia are available as flux, and together give just as much fluxing matter as the regular limestone. Mr. Keep ventures the opinion that burnt lime would be cheaper than this stone. This does not look reasonable, and the burnt lime is too dusty for foundry use as a large part would be blown out in the blast. The burnt lime, stored, absorbs moisture and carbonic acid, and approaches the condition of the original limestone.

I think the foundryman having a good quarry of magnesian limestone at hand would make a great mistake to pay the freight on limestone from a distance. I should be very glad to try a carload of magnesian limestone and would expect good results from it.

N. W. SHED.

PERSONAL.

Price G. Smith, who has had a wide experience in brass foundry work, has been appointed manager of the melting department of the Rockwell Furnace Co., New York City.

Harry E. Kerr, superintendent of the D. T. Williams Valve Co., Cincinnati, has resigned to accept a similar position with a large eastern concern.

Wm. J. Bird has been appointed assistant to Jos. M. Flannery, general manager of the American Vanadium Co., Pittsburg, to succeed T. F. V. Curran, resigned.

Alexander F. S. Blackwood, formerly manager of the Chester Steel Casting Co., Chester, Pa., has been appointed manager of the Michigan Crucible Steel Castings Co., Detroit.

W. G. Holmes, formerly connected with the American Car & Ship Hardware Co., New Castle, Pa., has resigned to accept the position of general manager of the Akron Brass & Bronze Foundry Co., Akron, Ohio.

George W. Craig, formerly general manager of the Fowler-Simpson Co., Cleveland, advertising agency, is now connected with the American Vanadium Co., Pittsburg, in the capacity of advertising manager.

Walter B. Snow, publicity engineer, 170 Summer street, Boston, announces the association with his staff of Carl S. Dow, late publicity manager of the B. F. Sturtevant Co., and formerly in charge of the instruction and textbook departments of the American School of Correspondence.

BOOK REVIEWS.

Metallurgy. By Henry Wysor. Easton, Pa. Chemical Publishing Co. 6 x 9 inches. 308 pages. Illustrated. Cloth. Supplied by THE FOUNDRY for $1.

This book contains much that is of value, despite the fact that it contains many errors. The text naturally divides itself into two parts. The first deals with the general principles underlying the science of metallurgy and the materials used in the arts and industries, the second with the principles of metallurgy as applied to practical ends. Here the author is more at home. His careful and detailed description of processes and finished products have in them a large element of value and the book may serve as the author says in his preface "as a guide to the science of metallurgy." Some of the more important errors are as follows:

In the first chapter, in his treatment of the physical properties of metals, the author states that "hardness is not a common property of pure metals." Yet hardness is the resistance of a substance to abrasion and characteristic in some degree of all solids.

In the second chapter, he states that "The only mines of graphite in this country of any importance are in New York." At the same time, in 1907, nine states and one territory contributed to the grand total of the output, and the state of New York together with that of Pennsylvania, produced approximately only two-thirds of the entire amount.

In the sixth chapter, the author gives in his list of common ores of the metals the chloride of lead, although the lead minerals bearing chlorine are rare, and the secondary mineral, the sulphate of lead, which is of considerable importance, he does not even mention.

In the eighth chapter, the author says that "Goethite is distinguished from limonite only in its water of combination." The former occurs in tabular and prismatic crystals while the latter never crystallizes. In the same chapter again, he places pyrite, FeS_2 as a chief ore of iron which in this country plays no part in the metallurgy of that most useful of all metals; and furthermore he makes pyrrhotite of formula Fe_7S_8, separating it from the magnetic sulphides of iron while pyrrhotite includes all the magnetic sulphides ranging from Fe_5S_6 to $Fe_{16}S_{17}$.

In the twenty-sixth chapter the author states that "Gold is only known to occur native and in combination with tellurium." Yet gold occurs in combination with bismuth as bismuth gold carrying 35.5 per cent of bismuth, in combination also with several rare elements and as gold amalgam in combination with mercury containing sometimes as high as 61 per cent of the latter metal.

It is unfortunate that the author went outside of his own field and fell into error. The field of mineralogy seems to lie outside the lines of his research.

POROUS CASTINGS.

By W. J. KEEP

Question:—I recently made a lot of kettles for glue works which were water jacketed in the bottom. In the center of the core was an opening about 3 inches in diameter which served to connect the inside metal of the kettle with the outside wall. The heavy section of the kettle was drilled to receive a spindle, but these parts of the casting were porous and permitted the water to leak through from the jacket to the inside of the kettle. What was the trouble with the iron?

Answer:—By reducing the silicon in your mixture or by using about 25 per cent of stove plate scrap you may be able to close the grain of your iron. I would recommend placing a cast iron chill, 3 inches in diameter and 2 inches thick, in the bottom of the mold. If this is not sufficient, place another of the same size in that part of the mold making the inside of the kettle. This will cause the 3-inch center to cool as rapidly as the rest of the casting. If your customer will permit it, you could make a chill for the inside having a pin inserted the size of the opening drilled in the side, and in this way this opening would be chilled and a sound casting insured. The soundness of the enlarged section of any casting can be insured by placing a chill over this part in the mold.

Dodge & Day, engineers, Philadelphia, have recently installed gas producers and regenerative gas furnaces, of their own design, in the plants of the Bradlee Chain Works and the Fayette R. Plumb Co., Philadelphia. In both of these installations the boilers, as well as the furnaces are fired by producer gas. This concern has also recently been commissioned by the Emerson Steam Pump Co., Alexandria, Va., to make a preliminary report and prepare plans for a new plant to be erected on the outskirts of Alexandria.

FOUNDRY & PATTERN SHOP EQUIPMENT

Alloy for Purifying Metals---Air Separator---Tilting Crucible Furnace---Indicating Pyrometer---Roll-Over Molding Machine---Jarring and Squeezer Machine---Overhead Molder---Rock-Over Jolt Machine---Traveling Scale Crane---Tumbling Mill

A NEW alloy for purifying metals having a copper base, known by the trade name of "Homogen," is being manufactured for the brass foundry trade by the Allyne Brass Foundry Co., Cleveland. This alloy is a metallic powder composed of brass filings chemically treated, which, it is claimed, removes the natural and acquired impurities of the metal. It increases tensile strength, elongation, elasticity and fluidity, removes sponginess and blow holes, closes the grain and neutralizes the iron in the metal.

This alloy is used in the proportions of 1 per cent of the entire amount of metal to be melted. A clean crucible should be selected which is charged in the ordinary way with scrap, sprues, gates or ingots. Immediately after the pot has been charged, and before the metal starts to heat, the required amount of this alloy should be poured over the charge. The remainder of the charge can then be added and treated as usual, charcoal being preferred. This alloy should not be added when the metal is melted, but must be introduced when the metal is cold.

Melting Turnings.

When using turnings or skimmings, the entire amount of "Homogen" is mixed with the first turnings placed in the crucible. When melting in open-flame furnaces, this alloy is mixed with not more than 10 per cent of the metal to be melted, and this mixture is charged into the chamber first, and the remainder of the charge is then added. "Homogen" is mixed with the turnings in this way to prevent the blast from blowing it out of the furnace. If turnings are not used, 2 per cent of this alloy is recommended in furnaces of this type.

This alloy melts down with the metal and the chemicals, leaving the brass filings at the same temperature at which copper melts, works its way through the molten mass, having a chemical action on the impurities, converting them into gases which burn off and add the weight of the carrier to the metal.

As shown in the accompanying table, the treatment of various mixtures with

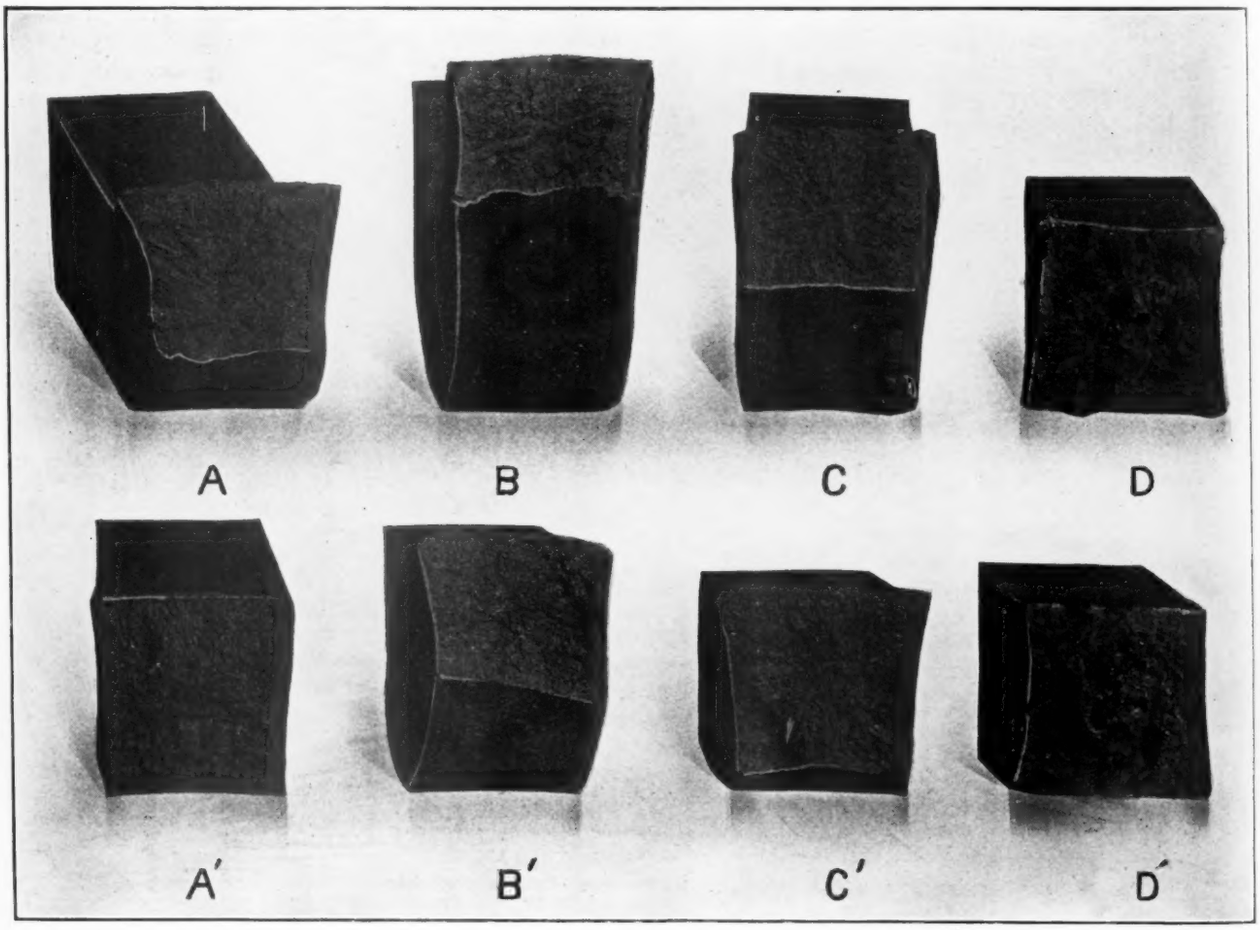


FIG. 1—FRACTURES OF BARS TREATED WITH "HOMOGEN" ARE SHOWN AT A, B, C, AND D. THE FRACTURES OF BARS NOT TREATED WITH THIS ALLOY ARE SHOWN AT A′, B′, C′ AND D′

this alloy increases the tensile strength from 2,550 to 6,500 pounds per square inch. It also increases the elongation and gives a greater reduction in area. Parsons bronze treated with "Homogen" showed an increased tensile strength of 6,500 pounds per square inch, 10 per cent greater elongation than untreated metal, and an increase of 4 per cent in reduction in area. The same comparative results were obtained with manganese, Tobin and other bronzes. The other metals treated were all standard mixtures generally used by the trade.

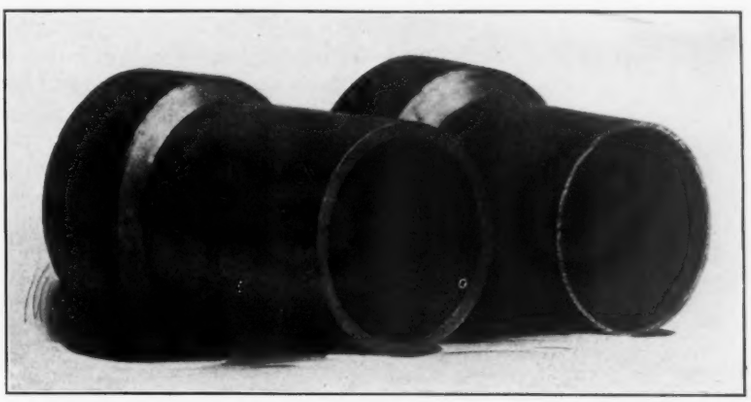


FIG. 2—TWO RED BRASS BUSHINGS. THE ONE OF THIN WALL SECTION TREATED WITH THIS ALLOY WITHSTOOD THE SAME PRESSURE AS THE UNTREATED BUSHING

Density of the Metal.

That the density of the metal is increased is clearly shown by fractures of the treated and untreated bars in Fig. 1. Bars A and A′ are made from the standard United States government mixture, containing copper 88, tin 10 and zinc 2. The fracture of the treated bar is shown at A and that of the untreated bar at A′. Bars made from standard red brass, new metal mixtures, are shown at B and B′. The bar at B was treated with this alloy, while B′ was not treated. The tensile strength of this metal was increased 3,300 pounds per square inch by the use of "Homogen." Fractures of bars made from a standard red brass mixture are shown at C and C′. The former was treated with this alloy and shows a much denser grain than the latter. The tensile strength was also increased 2,550 pounds per square inch.

The increase in the density of the metal is, however, more clearly defined in the fractures of the bars made from yellow brass scrap. The fracture at D is that of a bar treated with this alloy, while D′ was untreated. The tensile strength of the treated bar was increased 3,450 pounds per square inch, the elongation increased from 10 to 21.5 per cent, and the reduction in area from 11 to 21 per cent.

Two red brass bushings are shown in Fig. 2. The one, treated with "Homogen," is only 3/64-inch thick, and the other bushing is ⅛-inch thick. Both leaked at a hydrostatic pressure of 1,000 pounds. This is considered a remarkable test of the density of the metal, especially in view of the fact that the treated bushing was 5/64-inch less in thickness than the one not containing this alloy.

	Tensile strength, pounds, per square inch.	Increase in tensile strength, per square inch, by using "Homogen."	Elongation, per cent, in 2 inches.	Reduction in area, per cent.
Parsons Bronze.				
Treated with "Homogen"	70,300	6,500	22.½	21.
Not treated	64,800		12.½	17.
U. S. Government Standard Bronze.				
Treated with "Homogen"	41,200	3,400	15.½	16.8
Not treated	37,800		10.	11.
Red Brass, Virgin Metal.				
Treated with "Homogen"	34,950	3,300	43.5	35.
Not treated	31,650		36.	31.
Red Brass Scrap.				
Treated with "Homogen"	26,950	2,550	11.	6.
Not treated	24,400		7.½	4.
Yellow Brass, Virgin Metal.				
Treated with "Homogen"	32,900	2,800	46.½	40.
Not treated	30,100		35.½	31.
Yellow Brass Scrap.				
Treated with "Homogen"	25,750	3,450	21.5	21.
Not treated	22,300		10.	11.

THE PANGBORN MODERN AIR SEPARATOR.

The widespread application of compressed air to the various branches of foundry practice lends particular interest to a new device which has just been placed on the market by the Thomas W. Pangborn Co., New York. This device, shown in the accompanying illustration, takes advantage of the fact that the absence of moisture from compressed air means increased efficiency of all pneumatic equipment, longer life of both tools and hose and a material reduction in repairs and replacements. This separator consists of a steel tank or air chamber, of such size and shape as to permit its being placed wherever desired, a series of perforated baffle plates and an internal pipe arrangement. The air enters the separator through the inlet pipe which extends through the baffle plates almost to the bottom of the tank. This pipe is closed at the lower end, but is provided with small holes near the base, through which the air is expelled in small jets, against the walls of the air chamber. It then percolates up through and around the baffle plates to the outlet pipe, where it is delivered to the tools absolutely free from moisture. A drip cock in the bottom of the tank is provided for the removal of the moisture extracted.

The Hanna Engineering Works, Chicago, has purchased the patents and business of the Rathbone Molding Machine Co., Detroit, and hereafter will manufacture and sell the multiple type of molding machines. J. A. Rathbone and James T. Lee, formerly with the Rathbone company, are now connected with the Hanna Engineering Works.

PANGBORN AIR SEPARATOR

A TILTING, COKE-FIRED, CRUCIBLE, BRASS FURNACE.

The past few months have witnessed the initial installation in this country of a brass melting furnace of unique type, known as the M. R. V., which differs from the type ordinarily employed in America in the fact that the air blast employed in this connection is so light that only a small fan-blower, designed for volume as against pressure, is required, and coke only is used for fuel.

The construction of this furnace may be understood from the accompanying illustrations, which show its compact construction, a space only 6 feet square being required to set it up, no pit nor foundation being required. It consists merely of an outer shell of steel enclosing an air chamber, within which is an inner shell encasing a lining of refractory material. The furnace, which has a capacity of 400 pounds at a heat, carries a lining from 4 to 5 inches in thickness. The crucible is of a special type, being of equal height with the furnace, and rests on a solid base block of plumbago which in turn is supported by the bottom casting shown in Fig. 3. This crucible is largest at the top and tapers gradually to the base, a feature of the design which not only renders the charging of the metal more easy but also insures the steady settling of the coke, which is introduced at the top into the space between the refractory lining and the crucible. This coke space is some 5 or 6 inches in thickness at the base. In operation, this furnace makes use of a "contused" blast, rather than a "cutting" blast. This is secured without difficulty owing to the fact that the blast of air is introduced at a pressure of just under two ounces, and reaches the coke chamber in a roundabout way, passing first from the point of entrance at the top, down through the outer chamber and into the inner or combustion chamber through a series of staggered openings in the lining. The result of this arrangement is noteworthy in several important particulars. The life of the crucible is prolonged to a remarkable degree through the fact that the coke gives a soft, uniform heat, and that there is no direct application of flame. The makers state that 50 heats per pot is a low average life for this furnace, a statement which is borne out by the fact that during the writer's visit to the plant, when the accompanying photographs were taken, a crucible was removed after its 72d heat, and one recently exhibited has a record of 75.

FIG. 1—FURNACE IN MELTING POSITION. THE BLAST ENTERS THROUGH THE PIPE AT THE REAR

Aside from this economy in the item of crucibles, the furnace also shows a distinct reduction in loss through oxidization. The exceptionally small loss of metal in melting is of interest, as is also the provision made for recovering spilled metal or that flowing from a broken pot, so that no metal is mixed with the ashes. The furnace being entirely self-contained, the metal melted is uniform, the last being equally as hot as that first poured. The fuel consumption is also very low,

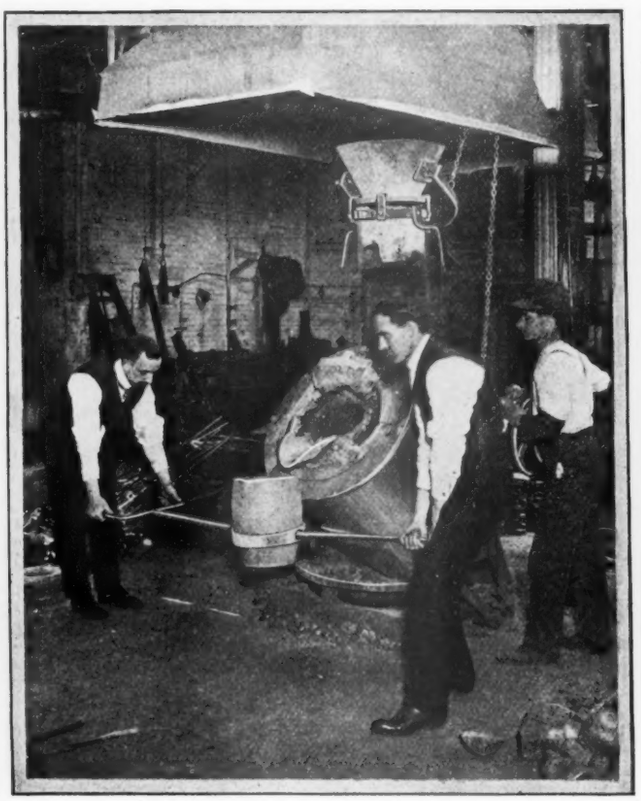


FIG. 2—FURNACE IN POURING POSITION

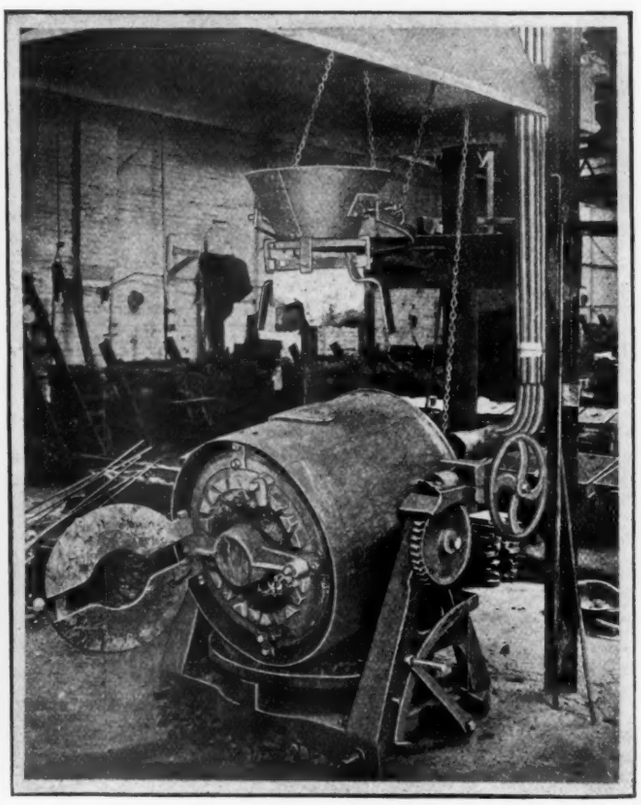
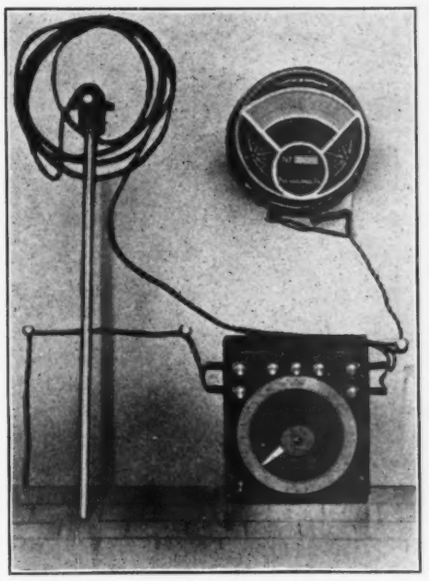


FIG. 3—BOTTOM VIEW OF FURNACE SHOWING SUPPORT FOR CRUCIBLE, THE BLAST PIPE BEING DISCONNECTED

averaging about one pound of hard coke to eight pounds of metal, although even more favorable results have been obtained. The resultant ashes and refuse are so small as to constitute a negligible item and contain practically no brass, which means a considerable saving. The furnace can be lined with either fire brick or carborundum fire sand, and ordinarily but one relining per year is necessary, although care must be taken to catch any incipient breaks about once a week. A hood is provided to remove smoke and fumes, and the operator is free from annoyance on this score as also from excessive heat.

The furnace has a capacity of 400 to 440 pounds per heat, a size which has been found to show maximum economies in point of fuel consumption and operating costs. An average run is seven heats per day, using either copper, gun metal or yellow brass, and the attention of only one man is required, giving a possible weekly output of seven or eight tons of metal with low labor charges. About one hour is required to melt a full charge of metal. For melting scrap, the furnace is equipped with a funnel, shown in Figs. 1 and 3, the contents of which gradually settle down, as melted, into the crucible. This funnel is counterbalanced and swings clear when the operation is complete, leaving the furnace top free of all encumbrances for tilting and pouring as illustrated in Fig. 2. The funnel is in place while the metal is being melted, thus closing the top with the exception of two narrow curved openings for the introduction of coke; over these, refractory shapes are laid. For pouring, the blast is discontinued and the connecting pipe at the back is slipped off before tilting.

The first American installation of this furnace was at the plant of the Nathan Mfg. Co., 416 East 106th street, New York City, where two 400-pound furnaces are now in operation, and arrangements are being made to equip the entire foundry with this type. It is estimated that only 5 horsepower wil be required to provide the blast for five furnaces of this size. This furnace is being manufactured by J. B. Wise, Watertown, N. Y., and R. F. Goyne has been retained as expert demonstrator.



INDICATING PYROMETER

A NEW TYPE OF INDICATING PYROMETER.

The Leeds & Northrup Co., Philadelphia, is now manufacturing a pyrometer for use in hardening and annealing furnaces and similar purposes, which can be set to any desired temperature below 1,800 degrees, Fahr. The pyrometer, shown herewith, consists of three parts, including the bulb, the indicator and the deflector. The bulb, suitably protected, is inserted in the furnace while the operator watches the handle of the deflector and may or may not see the indicator. The instrument is based on the measurement of temperature by means of the measurement of the change in electrical resistance of pure platinum. The scale of the deflector, which is in reality, an ordinary volt meter, provided with a special scale, is divided into 100 divisions each side of a central zero. When the temperature is 50 degrees higher than that desired, the needle stands approximately on the +50 mark. When it is 75 degrees too low the needle will point to the —75 mark, etc. By turning the index on the indicator, the temperature corresponding to zero may be varied at will. Thus, if it is desired to treat a piece of steel at 1,380 degrees, Fahr., the index is set at 1,380 and the temperature of the furnace is raised until the needle points to the center of the scale. If the next piece is to be heated to 1,420 degrees, Fahr., the index is set at 1,420 and the needle is again brought to the center of the scale. On the deflection indicator of this instrument, ⅛-inch corresponds approximately to 5 degrees, and the deflection, while it does not give the operator the temperature of the furnace, indicates immediately whether it is at the required temperature or not. With care, this pyrometer is readable to 2 degrees and a change of 20 degrees is immediately noticeable.

UNIVERSAL, ROLL-OVER, MOLDING MACHINES.

A roll-over, straight drop molding machine with side frames adjustable for molding short and long patterns, and which can be raised and lowered for various depths of cope and drag, built

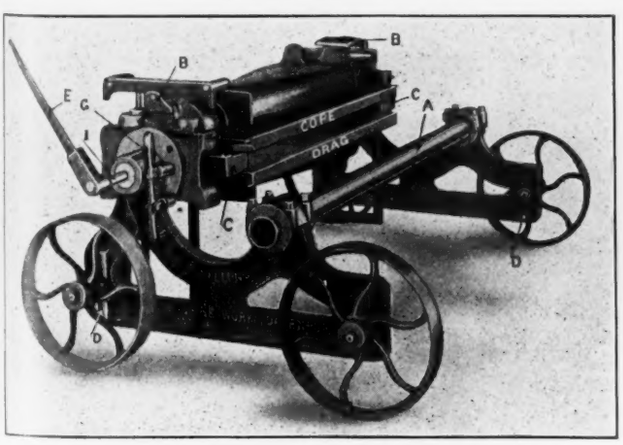


FIG. 1—VIEW OF ROLL-OVER, STRAIGHT DROP MOLDING MACHINE, SHOWING PIPE WHICH HOLDS THE ADJUSTABLE SIDE FRAMES

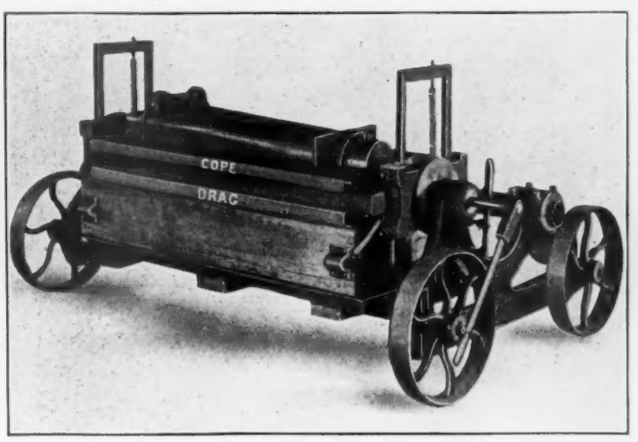


FIG. 2—DRAG ROLLED OVER AFTER THE BOTTOM BOARD HAS BEEN ADJUSTED AND CLAMPED

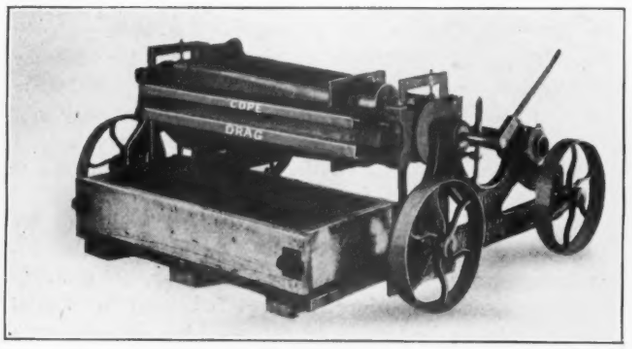


FIG. 3—MOLD DROPPED AWAY FROM THE PATTERN AND DEPOSITED ON THE FLOOR

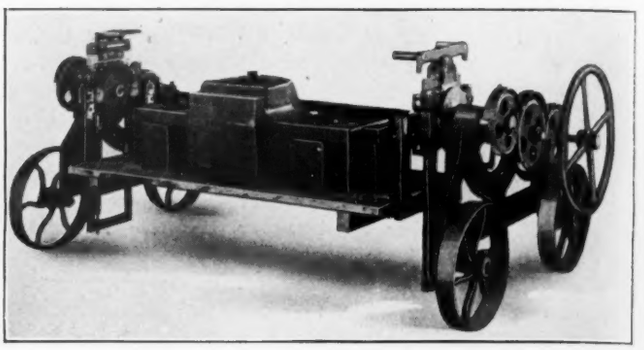


FIG. 4—FRONT VIEW OF TYPE B, UNIVERSAL, ROLL-OVER, STRAIGHT DROP MOLDING MACHINE

by the E. Killing's Molding Machine Works, Davenport, Iowa, is shown in the accompanying illustrations. It has been especially designed to meet the varying requirements of the jobbing foundry, and is adapted for a wide range of work, as the height and width can be increased or decreased as desired, depending upon the size of the pattern.

The frames are held together by a steel pipe A, Fig. 1, which can be replaced by a shorter or longer section to increase or decrease the width of the machine as required. Another shaft, I, is also used as the width is changed, to which are attached the clamps and the flask lowering device. For raising and lowering the machine the frames are slotted at four points D. Both cope and drag can be molded on the machine, on which can be mounted single match plates on pattern boards with the cope and drag patterns on their reverse sides. The pattern boards are mounted on forks C, Fig. 1, the cope pattern being uppermost in this illustration in position for receiving the flask for ramming the cope half of the mold.

In Fig 2 the drag has been rolled over after the bottom board has been adjusted and clamped. The mold is then dropped away from the pattern and deposited on the floor by the lowering device, after which the clamps B are released, and the pattern is elevated above the flask by throwing back lever E, as shown in Fig. 3.

A front view of a type B, universal roll-over, straight drop molding machine, designed for the use of a single pattern plate, but upon which both cope and drag can be molded, is shown in Fig. 4. All of the important features of the smaller machine, shown in Figs. 1, 2 and 3, are embodied in this machine, but, as illustrated in the rear view, Fig. 5, the steel pipe connecting the frames is in two sections, being held by a flanged tube, bolted together. By this arrangement the width of the machine can be increased or decreased as desired. The drawing of the pattern is accomplished by a shaft passing through the steel pipe in the rear of the machine, to one end of which a hand wheel is attached. The machine can be successfully used on patterns having a draft of 18 inches, and in Fig. 6 is shown a mold which, together with the 28 x 60-inch flask, weighs 1,000 pounds.

SAND MIXING MACHINE.

The Auto sand mixer, a new departure in foundry equipment which was brought out recently by the Sand Mixing Machine Co., 220 Broadway, New York city, is shown in the accompanying illustrations. In this device its manufacturers believe they have produced a machine which will give absolutely uniform results, cutting molding sand in such a manner as to rival the riddled product in appearance and texture, and at the same time effect an extremely large saving in labor expense.

The principle upon which this machine is constructed is apparent from the illustrations. It consists merely of a double set of revolving knives, arranged for operation at any distance from the floor and with the carriage upon which they are mounted either in motion or stationary. In both the propulsion and operation of the machine, the drive is by an electric motor mounted near the front of the carriage, securing its current from a flexible cable running on an automatic take-up reel. The knives of the cutting cylinder are arranged in double section and are bent spirally toward the center, the result being that the sand is drawn inward constantly and is in this way deposited in a conical heap, as with hand treatment. The transmission has two speeds for-

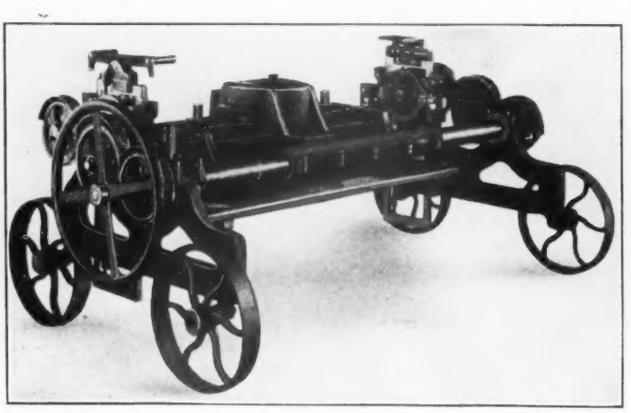


FIG. 5—REAR VIEW OF TYPE B MACHINE SHOWING STEEL PIPE CONNECTING ADJUSTABLE SIDE FRAMES

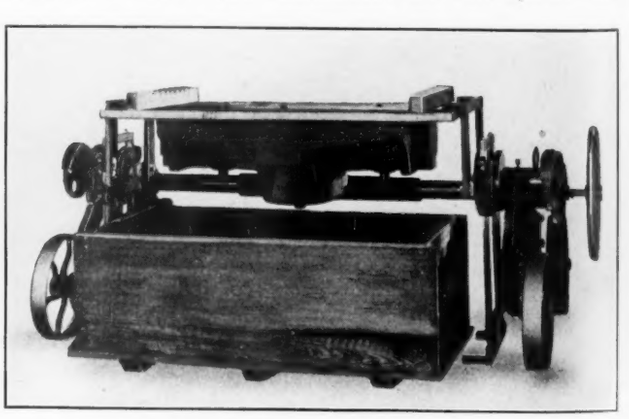


FIG. 6—LARGE MOLD MADE IN A 28 x 60-INCH FLASK, WEIGHING 1,000 POUNDS, PRODUCED ON A TYPE B MACHINE

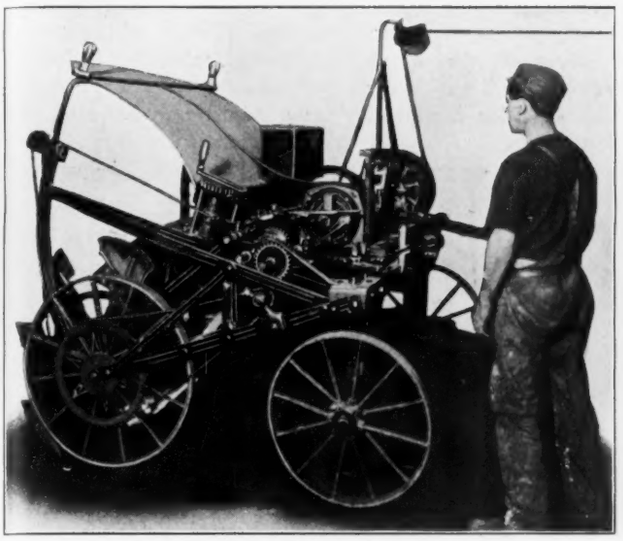


FIG. 1—SAND MIXING MACHINE SHOWING OPERATING MECHANISM

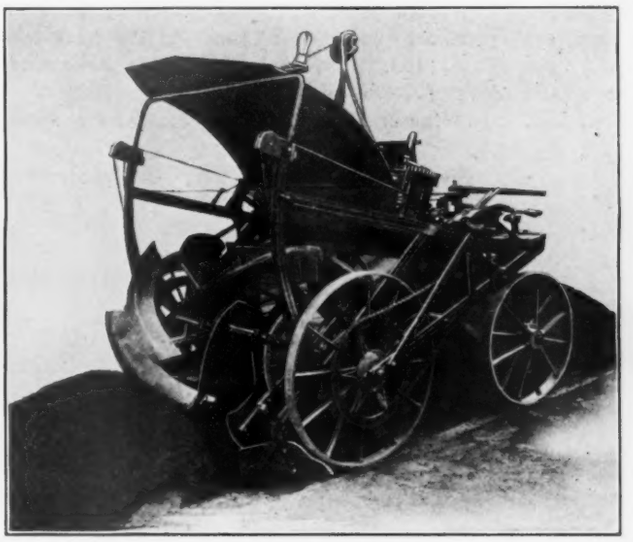


FIG. 2—VIEW OF SAND MIXING MACHINE SHOWING CUTTING KNIVES

ward, one for cutting and one for moving to position, and also two reverse speeds. The cutting knives are controlled by a multiple disk clutch, which will slip and prevent breakage in case they strike a heavy casting or gate left in the sand.

In operation, the machine is backed into position immediately over one end of and straddling the heap of sand on the floor where it has been shaken from the molds. It remains stationary while the cutting knives are gradually lowered, cutting their way down through the sand and throwing it back in a conical heap. As soon as they have cut to the floor, the low-speed forward clutch is thrown into position and the machine travels down through the heap, at the rate of 15 to 20 feet per minute, cutting the sand with strokes ½-inch apart, which is insurance against any lumps remaining. The carriage is so constructed that it can turn almost on its own wheel base, allowing it to straddle large castings or other interfering objects and to operate in cramped and difficult places. Operated by one man, it can cut all the sand required for 100 to 150 molders, the usual method being to work it at night so as to have the tempered sand ready for the molders at starting time.

The operation of the cutting knives has a riddling effect upon the sand treated; it is tossed up sufficiently high to allow all the steam and gases to escape, or, in other words, it is aerated, being deposited light and "live," so loosely packed that the arm can readily be thrust through it. The manufacturers of this machine state that because of this aeration process there is a noticeable improvement in the appearance and molding qualities of sand after each cutting, until it reaches a certain condition below which it does not fall so long as the treatment is continued. It is never "dead" and heavy, yielding a large percentage of losses, but on the other hand, because of its lightness and the ease with which it riddles, can be handled by the molder at considerably greater speed than hand cut sand.

This machine is already in operation at several of the larger foundries, and is particularly suited for use in plants working 30 or more molders.

PORTABLE JARRING AND SQUEEZER MACHINE.

The Parks portable jarring and squeezer molding machine, shown in the accompanying illustrations, is

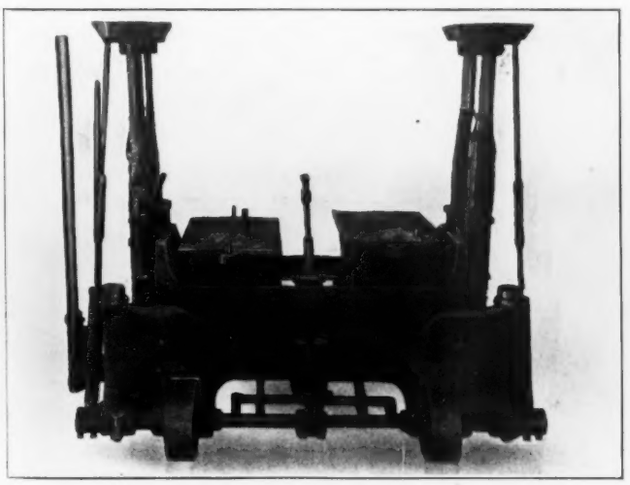


FIG. 1—COPE AND DRAG PATTERN PLATES ATTACHED TO CRADLE OF PORTABLE JARRING AND SQUEEZER MOLDING MACHINE

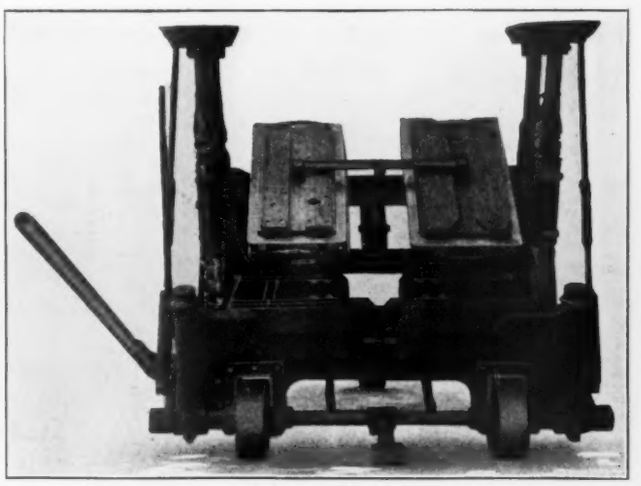


FIG. 2—CRADLE IN TILTED POSITION AFTER THE FLASK HAS BEEN CLAMPED

adapted for a wide range of snap flask work and produces both cope and drag in one operation. In Fig. 1 the cope and drag pattern plates have been fastened to the cradle of the machine by bolts which hook over rods attached to the bottoms of the pattern plates. The flasks are placed on the pattern plates, filled with sand and the cradle is jarred by means of a foot lever, thereby packing the sand uniformly in the molds regardless of the shape of the pattern. After the cope and drag halves of the mold have been jarred, cope and bottom boards are placed on the flasks and the molds are clamped by a bar, as illustrated in Fig. 2, which also shows the cradle in a tilted position. The cradle is then raised by depressing the foot lever and reversed.

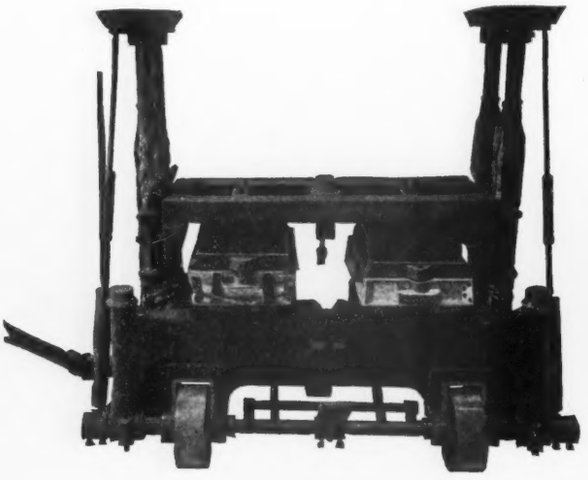


FIG. 3—CRADLE IN REVERSED POSITION

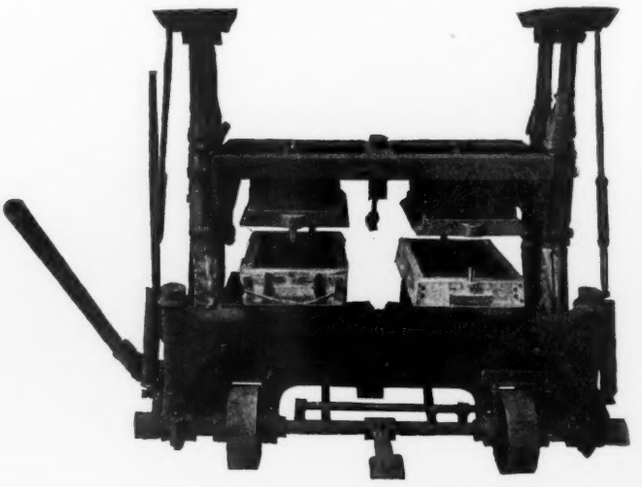


FIG. 4—COPE AND DRAG HALVES OF THE MOLD AFTER THE PATTERNS HAVE BEEN DRAWN

The cradle in its reversed position is shown in Fig. 3 and the molds are squeezed by the large hand lever shown on the left. As soon as the pressure is applied, the clamping bar drops off and falls underneath the machine where it is held in position for the next operation.

The cope and drag halves of the mold, after the patterns have been drawn, are shown in Fig. 4. This is accomplished by a positive pattern-drawing device on a shaft operated by a lever which draws the patterns a certain distance from the molds after which the cradle is raised to its full height by the foot lever. After the patterns have been drawn the flasks are moved out from underneath the cradle, as shown in Fig. 5. The beds on which the cope and drag rest are actuated by the smaller of the two levers at the side of the machine. The mold is then closed and the snap flask removed, as shown in Fig. 6.

After the mold has been placed on the floor, the cast iron beds are returned to their original positions by throwing back the smaller lever and the cradle is reversed by throwing back the larger lever. The pattern plates are then in their original position for making the next mold.

The machine is well constructed to insure rigidity, the upright shafting being made of square, cold rolled steel. Wear on the cradle ends can be taken up by adjusting the caps on the sliding boxes. The large springs on each side of the machine are used for adjusting the cradle to the varying weights of flasks and pattern plates placed thereon. The machine is mounted on three wheels, can easily be moved along the floor and has a draft of 8 inches. The machine is built in two sizes for flasks 12 x 18 inches or smaller and 16 x 24 inches, by the A. Buch's Sons Co., Elizabethtown, Pa.

The Osborn Mfg. Co., Cleveland, is sending a four-page pamphlet to the foundry trade, which briefly describes the Osborn rock-over, drop draft, molding machine. Reference is briefly made to four important improvements in molding machine construction embodied in this machine.

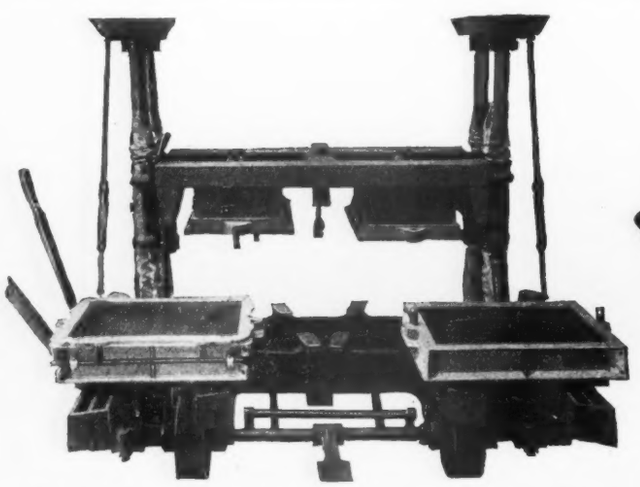


FIG. 5—MOLDS MOVED OUT FROM UNDERNEATH THE CRADLE

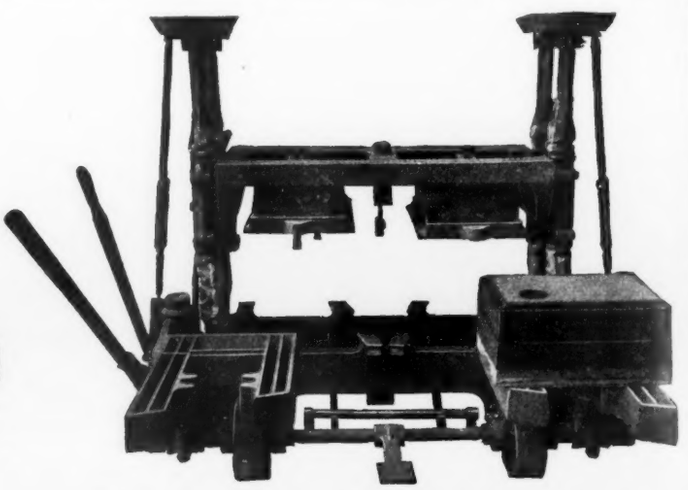


FIG. 6—MOLD CLOSED AND SNAP FLASK REMOVED

CURTIS-MUMFORD OVERHEAD MOLDER.

The jolt ramming of molds has extended to such sizes as finally to have exceeded the capacities of pattern-drawing mechanism fitted to the machine, especially when the pattern-drawing is of the roll-over variety. Pattern draft attached to the machine furthermore ties up the machine while the patterns are being drawn, and as this construction involves the use of a pattern frame attached to the machine, the latter is idle while the flask is being filled, a two-fold loss which does not occur with the use of this device. A hoist or crane of large capacity is an essential adjunct of a large jolt ramming machine, and its constant attendance is required by the exceptionally short time consumed in ramming molds by this method.

It was with the above points in view that the Curtis-Mumford overhead molder, shown in the accompanying illustrations, was designed and built. It combines roll-over and pattern draft mechanism with crane and hoist service. The machine shown herewith has a capacity for handling molds 6 x 8 feet, and weighing not more than 9,000 pounds, when supplied with 80 pounds of air pressure. The machine conveys the follow-boarded pattern, with the flask filled with sand on the floor, onto the table of the jolt ramming molding machine. After the mold has been rammed, it lifts the flask from the machine, rolls it over by power and draws the pattern while the mold is suspended. The method by which this is accomplished is apparent from a reference to the illustrations. In Fig. 1 the flask is shown suspended with the bottom board uppermost, and in Fig. 2 the mold has been rolled over and the pattern drawn. The large cylinder provides power for lifting 9,000 pounds, 6 feet, and when a foundry crane of large capacity is available, the machine is limited only by the size of the flask, and the large cylinder at the top is not required.

Projecting from the bottom of the cylinder is a device that appears to be a plunger. This is the pattern-drawing cylinder, the plunger of which carries the cross pendant provided with four arms, to which are attached four small spuds. These spuds slide readily in slots and are never rigidly tightened. They automatically adjust themselves to such points on the back of the pattern or follow-board as they might find resting place upon during the pattern-drawing operation. While the mold is suspended on the hangers pendant from the cross rail, the pattern-drawing plunger, which is square, is dropped with its cross and the four spuds upon the back of the pattern or follow-board. As soon as it contacts with the pattern or follow-board, it automatically sets up a pressure of 700 pounds thereon. As the valve controlling the roll-over mechanism is now at lap, so that the flask is free to adjust itself axially on the trunnions, the contact of the first two spuds which bear throw the joint of the mold square in one direction with the line of pattern draft, which is the line of the plunger. In order to complete the adjustment, the hanger opposite the one to which the roll-over cylinder and sprocket wheels are attached is lengthened or shortened by an adjusting screw, driven by a 12-inch hand crank through miter pinions. This brings the other two spuds in contact with the back of the pattern or follow-board, thus squaring the mold joint with the pattern draft in the other direction.

Simultaneously with the pressing down of the spuds to square the joint with the line of draft, a pair of grab hooks at the end of the pattern-drawing plunger seizes a button-headed plate in the back of the pattern or follow-board. Upon the starting of the pattern draft these pull the pattern from the sand, while the four spuds still maintain a downward pressure which holds the pattern rigidly.

Before starting the pattern draft, the flask is rapidly secured against rolling

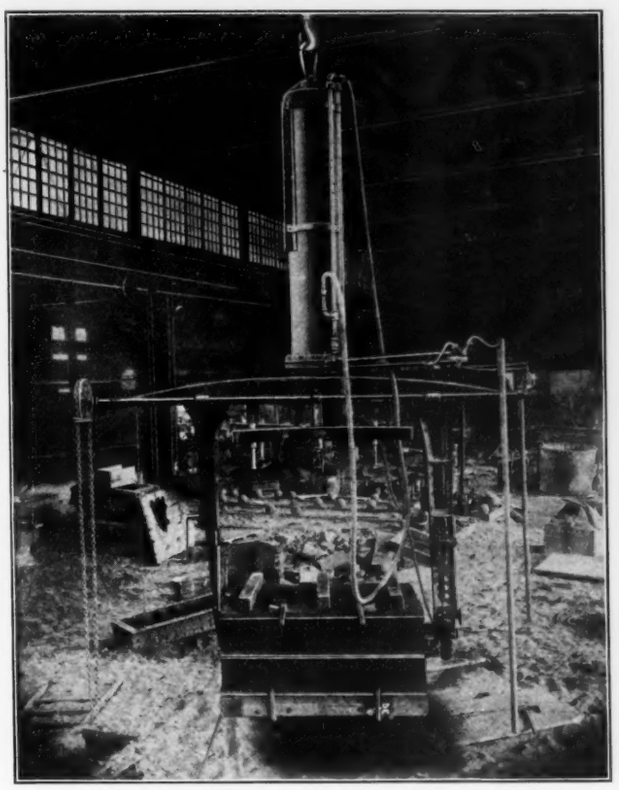


FIG. 1—CURTIS-MUMFORD OVERHEAD MOLDER CONVEYING A MOLD BEFORE ROLLING OVER

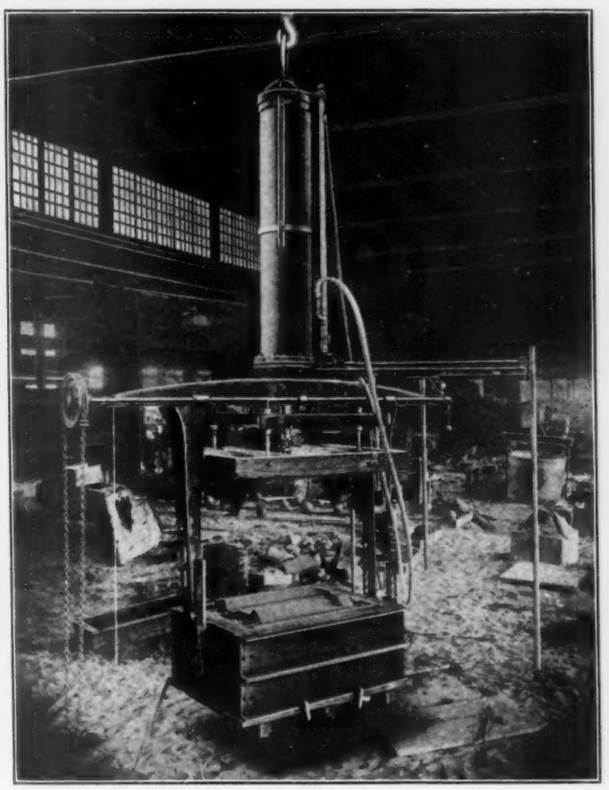


FIG. 2—MOLD ROLLED OVER AND THE PATTERN DRAWN

on its trunnions by the same mechanism which is used to roll it, and being so held, and the pattern also rigidly held, the pattern draft is absolutely clean, unaffected by uneven bottom boards, insufficient bedding devices, etc.

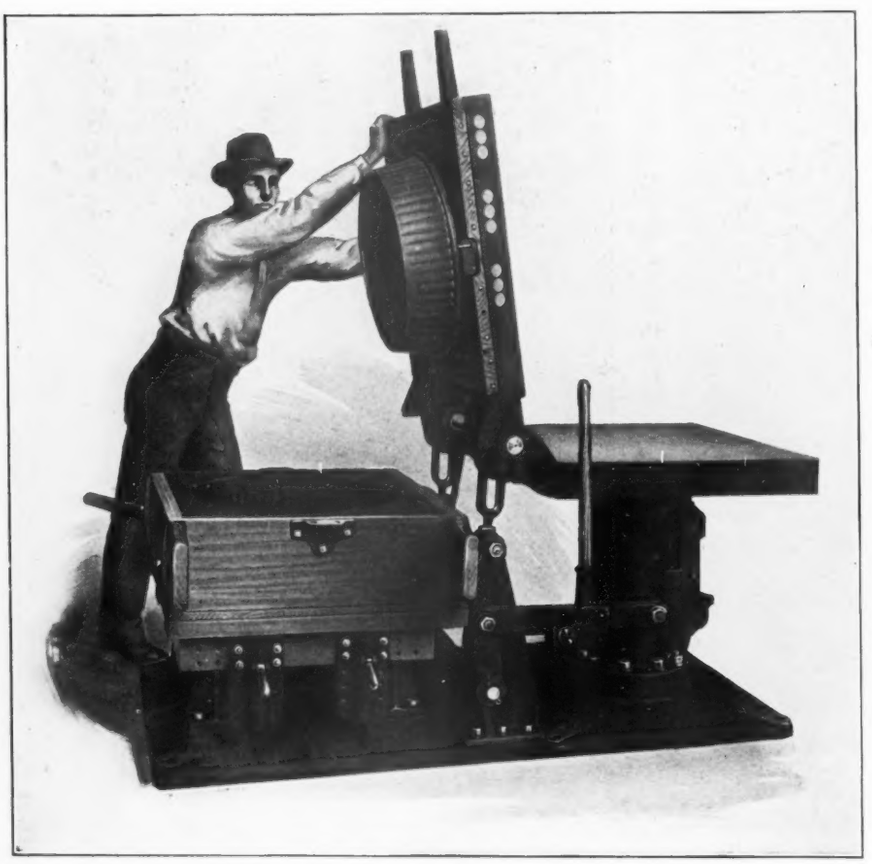
The hangers from which the mold is suspended may be set to correspond with any length of flask up to 8 feet. At the exposition of foundry equipment and supplies held in Cincinnati, where this device was shown, a half mold weighing 3,000 pounds was made in 4½ minutes by one operator and two helpers. This included the filling of the flask, the rolling-over of the mold, the drawing of the pattern and the lifting of the mold from the machine to the floor.

The apparatus may be used with a special cradle for handling large split core boxes and also for shaking out and handling flasks if this is required.

No change in patterns, follow-boards or flasks of any sort is required except a fixture for the roll-over drive, permanently fastened to the end of any flask, wood or metal. It will readily be seen that it is not essential to the operation of this apparatus that the pattern should be secured to the follow-board and drawn with it, which always involves a blind lift. It is one of its great advantages that the follow-board may be loose and removed from the pattern before it is drawn, which, as in the case of spur gears, gives an opportunity to watch corners which may stick and start with the pattern, and to nail such parts as will not draw without nailing. Inasmuch as neither patterns nor follow-boards are in any way secured to the machine, but are simply picked up by it, it will take at random flasks which have been filled on their follow-boards by a shoveling grab. The overhead molder is built by the Curtis & Co. Mfg. Co., St. Louis.

ROCK-OVER JOLT MOLDING MACHINE.

The Osborn Mfg. Co., Cleveland, has applied many of the features of its rock-over, drop-draft molding machine to a rock-over, jolt machine for heavy floor work. It has a capacity for molds weighing up to 700 pounds, and can be used for any floor work suitable for ramming on jolt machines. It is designed to be set about 12 inches below the floor level so that the pattern plate is 26 inches above the floor line, making it a convenient height for shoveling sand, finishing, etc.



OSBORN ROCK-OVER, JOLT MOLDING MACHINE

As shown in the accompanying illustration, the pattern plate and roll-over table are hinged to the table of the jolt ramming machine, and the latter can be used for plain jolt ramming by removing the pattern plate. The rolling-over of the mold is facilitated by springs, the tension of which is governed by a cleverly designed jack. The length of the stroke of the jolt ramming machine cylinder can be reduced to 3/16-inch if desired, and this is governed by adjusting the port valve.

When making a mold, the flask is placed on the pattern plate, bolted to the roll-over table and resting on the table of the jolt ramming machine. After the mold has been rammed, the bottom board is adjusted and held in place by specially designed toggle clamps. The springs are then thrown in tension by the lever actuating the jack, and the mold is rolled over, the bottom board coming into contact with four leveling posts. After the bottom board has been leveled the posts are clamped and the mold is dropped away from the pattern. The machine has a draft of 6 inches before rocking out and is adapted for deep and heavy work. It will take a flask up to 33 x 33 inches and any depth from 3 to 10 inches. While this machine is made in only one size, plain jolt machines will be built in various sizes with tables from 33 x 33 inches to 60 x 96 inches, and with lifting capacities varying from 1,000 to 20,000 pounds.

MIXTURE FOR PROPELLERS.

Question:—We are experiencing considerable difficulty in casting propeller wheels weighing from 15 to 125 pounds. The metal is not sufficiently fluid to pour the castings, and when poured very hot it eats into the cores and sand. We are using all scrap consisting of copper, 28 pounds; red brass, 51 pounds; yellow brass, 15 pounds and lead, 5 pounds. We are also making gear wheels and are using copper, 66 pounds; yellow brass, 6 pounds; tin, 6 pounds and lead, 2 pounds. We also find that this metal is not sufficiently fluid. Our castings are a dull black when they are shaken out of the sand and we would like to know whether this is due to the large amount of scrap we are using.

Answer:—The metal you are using cannot be considered an exceptionally good one for propeller wheels. Assuming that the red brass which forms the bulk of the mixture has been given all the lead it required by the original maker, you are adding five more pounds of lead to 38 pounds of copper, that is, figuring the copper from the yellow brass. Your mixture practically contains copper, 38 pounds;

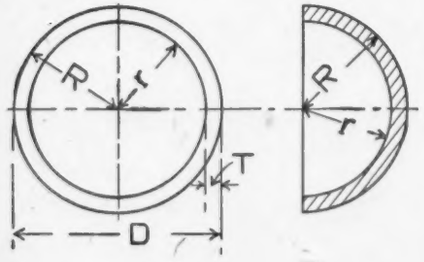
THE FOUNDRY DATA SHEET, JUNE, 1909.

Payment will be made for all contributions on foundry and pattern shop practice suitable for publication.

FORMULAS FOR FINDING THE WEIGHT OF IRON CASTINGS.

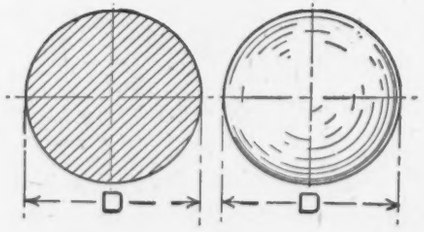
To find the weight of a hollow hemisphere, multiply the thickness by the small radius plus the thickness divided by 2, squared, by 1.652:

$$W = \left(r + \frac{T}{2} \right)^2 T \times 1.652.$$



To find the weight of a solid sphere, multiply the diameter cubed by 0.1365:

$$W = D^3 \times 0.1365.$$



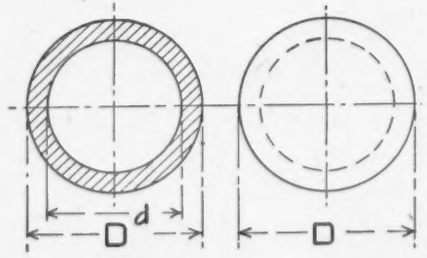
W = Weight of casting in pounds.
R = Outside or large radius in inches.
r = Inside or small radius in inches.
T = Thickness in inches.
D = Outside or large diameter in inches.

Data Sheet No. 43, The Foundry, June, 1909.

FORMULAS FOR FINDING THE WEIGHT OF A HOLLOW IRON SPHERE AND A BODY OF RAMMED SAND.

To find the weight of a hollow sphere multiply the outside diameter cubed, minus the inside diameter cubed, by 0.1365:

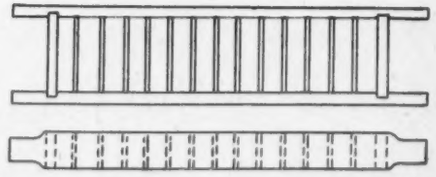
$$W = (D^3 - d^3)\ 0.1365.$$



W = Weight of casting in pounds.
D = Outside or large diameter in inches.
d = Inside or small diameter in inches.

To find the weight of a body of rammed sand, multiply the length by the breadth by the height in feet, by 87:

$$W = L\ B\ H \times 87.$$



W = Weight of body of sand in pounds.
L = Length of body of sand in feet.
B = Breadth of body of sand in feet.
H = Height of body of sand in feet.

Data Sheet No. 44, The Foundry, June, 1909.

Note—This sheet may be cut into two sections, 5 x 7 inches, and may be readily bound in note-book form.

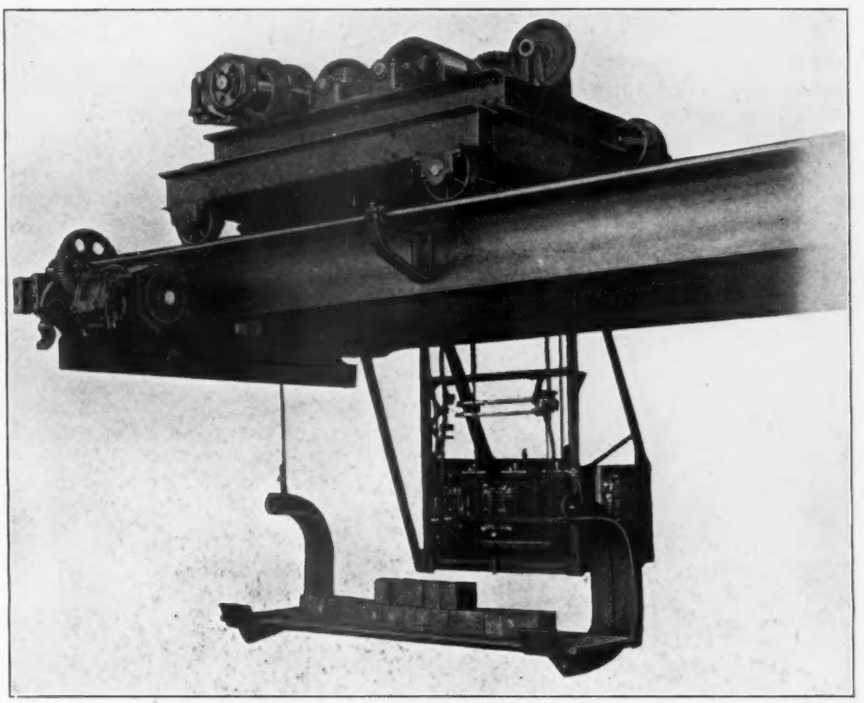
zinc, 5 pounds; lead, 5 pounds and scrap, 51 pounds. If you try this metal without any scrap you will find it very poor, entirely unsuited for such purposes, and you would do better to use scrap entirely. A better alloy would be an aluminum brass or a cheap manganese bronze. You will have to pour your red metal quite hot to run the blades of the propellers.

The black color is caused by the iron, and the excessive fluidity which causes it to cut into the sand when the metal is poured hot is due to the phosphorus. Your scrap, therefore, probably contains both phosphorus and iron, a bad combination. It is advisable to remove all visible iron, such as screws, rivets, etc., before melting the scrap. If your copper is all scrap it may contain iron, which has to be removed before using. Furthermore, if your copper is in the form of old wire and you purchase it in balls, it will pay you to investigate these balls as you may find iron there. If the scrap is largely composed of old valves the iron, in all probabilities, is alloyed with the metal, as it is used in high pressure steam goods to close the grain.

With regard to gear wheels your alloy is satisfactory, but you are probably pouring it too cool. It also contains iron or the castings would not turn black. You cannot possibly get orange or gold colored castings with this alloy. The color, however, should be pleasing, and the castings should look like brass. I imagine you are using scrap copper and advise a trial of ingot copper.—K. K.

ELECTRIC TRAVELING SCALE CRANE.

A three-motor, electric traveling scale crane, all movements of which are accomplished by electric power, built by the Whiting Foundry Equipment Co., Harvey, Ill., is shown in the accompanying illustration. The scales are supported on a trolley truck frame and carry the hoisting mechanism on an independent, steel frame-work. The scale beams are in the cage suspended from the trolley and readings are taken and recorded by the operator. The crane is provided with three beams, two scale beams with several recording poises and one tare beam, permitting the scale weights of several different items of material to be easily and accurately determined. A movement of the hand lever transfers, when desired, the load from the knife edges of the scale to the trolley truck frame and the operation thereafter is the same as with an ordinary trolley.

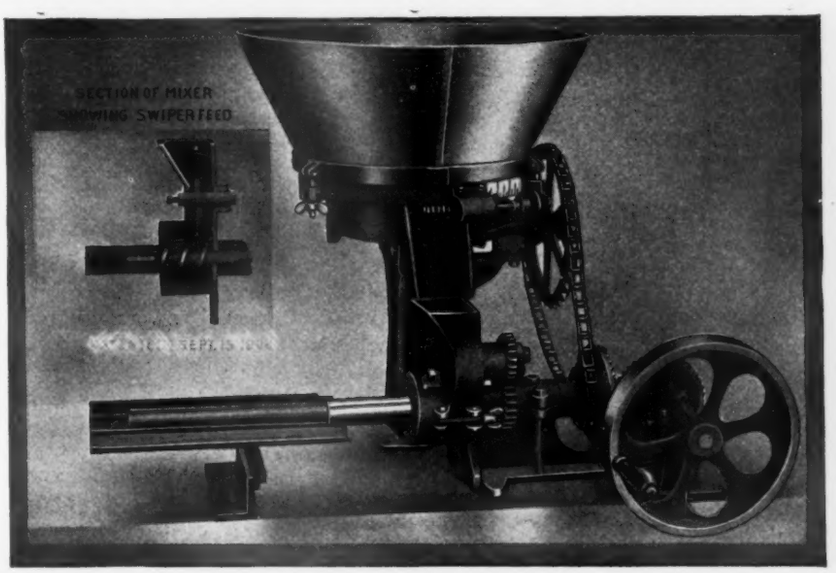


ELECTRIC TRAVELING SCALE CRANE

An open side platform, as shown, is furnished for carrying long pieces such as bars, rods, etc. This platform is, however, designed to suit the material to be handled. The crane is adapted for weighing material when loading, checking invoiced weights, loading for shipment, for inventory, etc. Six of these cranes of 5 tons capacity each, having a span of 37 feet 10¾ inches, have just been completed for installation in the new warehouse of the Scully Steel & Iron Co., Chicago.

CONVEYOR CORE MACHINE.

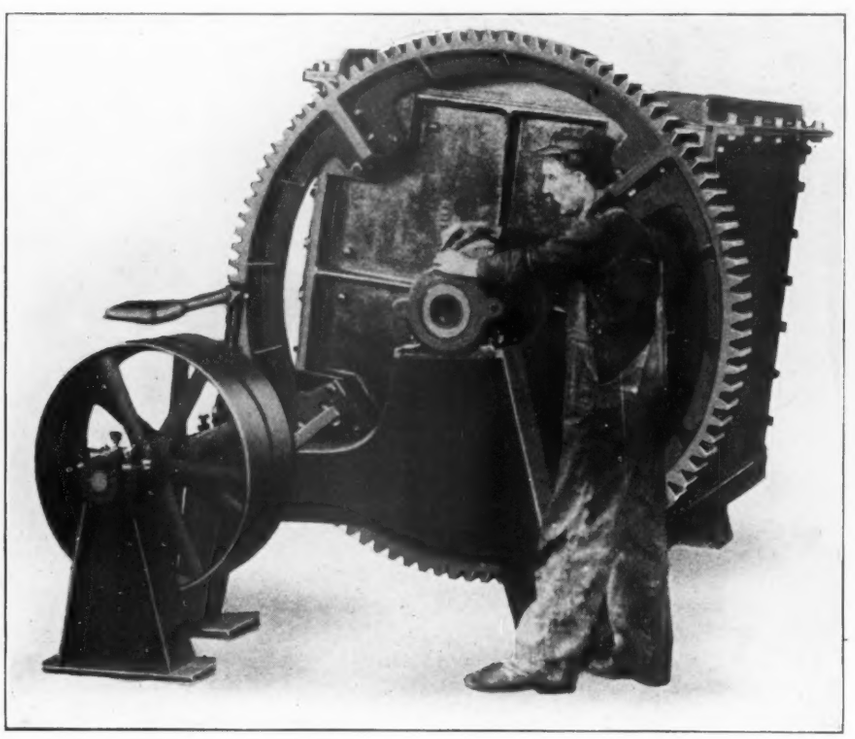
A new, conveyor type machine for making stock and irregular cores, the principal features of which are the large self-feed hopper and the swiper feed, is shown herewith. The hopper has a capacity of a bushel or more of sand, and by opening and closing a gate the sand can be fed into the mixer at any speed, according to the size of the core that is being made. The swiper is geared to operate between the flights of the conveyor, and feeds the sand into the upper half of the conveyor, while it is fed by gravity into the lower half, thereby greatly increasing its capacity and reducing the wear on the same. Regular cores from ⅜ to 3 inches can be made and dies are furnished for any irregular and special cores. This maachine is manufactured by the Diamond Clamp & Flask Co., Richmond, Ind.



CONVEYOR TYPE CORE MACHINE

A LARGE TUMBLING MILL.

A large, square tumbling mill, 44 inches long, 42 inches wide and 50 inches high, built by the Whiting Foundry Equipment Co., Harvey, Ill., is shown in the accompanying illustration. The ends are made of heavy cast iron and are provided with handles so that they can be easily removed. The sides are made of ¾-inch steel plates to which the ends are bolted. The trunnions are made of cast steel and to one is attached a cast iron dust box for an exhaust system connection. The trunnions operate on hard steel rollers and the standards supporting the mill are cast iron, of angular section, and have ample foot plates. The standards contain the bearings for the trunnions and the driving shaft. A heavy, semi-steel gear, built in four segments is bolted to one end of the tumbling mill. The view shown herewith illustrates the driving end of the mill which is now in operation at the Manufacturers' Foundry Co.'s plant, Milwaukee.



LARGE STEEL PLATE TUMBLING MILL FOR CLEANING HEAVY CASTINGS

TRADE NOTES.

Gulick, Henderson & Co., Pittsburg, industrial chemists and engineers, have been incorporated under the firm name of the Gulick-Henderson Co. Officers have been elected as follows: President, Henry Gulick; vice president, W. O. Collins; treasurer, W. P. Gulick. The business was formerly conducted as a co-partnership and the incorporation involves no change in policy.

The Independent Pneumatic Tool Co., Chicago, has moved its general offices from the First National Bank building to 1307 Michigan avenue, where larger quarters have been secured.

The B. F. Sturtevant Co., Hyde Park, Mass., has recently issued two handsomely illustrated bulletins, Nos. 105 and 106, devoted respectively to gas blowers and exhausters, as well as small electric ventilating sets. The latter are designed for ventilating rooms in private dwellings and public buildings and for blowing dust out of machinery in power houses, shops and mills.

What might be termed a pocket edition, general catalog has just been issued by the Jos. Dixon Crucible Co., Jersey City, N. J. It lists the principal products made by this concern, such as crucibles, facings, lubricating graphite, greases, pencils, protective paint, etc., giving brief descriptions and prices. The booklet is of commercial envelope size, is substantially bound and attractively printed.

L. E. Burton has been placed in charge of the sales department of the American Blower Co., Detroit, for the states of Washington, Oregon and Idaho, with headquarters in the Arcade Annex, Seattle, Wash.

The E. E. Squier Co., 1520 Bank of Commerce building, St. Louis, has taken over the St. Louis office of the Chesapeake & Ohio Coal & Coke Co.

TRADE PUBLICATIONS.

FOUNDRY SUPPLIES AND EQUIPMENT.—The Hill & Griffith Co., Cincinnati, manufacturer of foundry facings, supplies and equipment, has issued a handsomely illustrated catalog containing 646 pages, which gives descriptions and prices of practically all of the materials and equipment required in iron, steel, brass and malleable foundry work. The catalog is unusually complete and should prove a valuable work of reference to every foundryman. Its compilation was a stupendous task as it contains nearly 1,000 illustrations, and it reflects great credit upon the concern by which it was issued. The opening pages contain interesting, as well as entertaining "don'ts" and pointers for the foundryman, while the chapter on graphite, plumbago, silver and black leads is replete with valuable information regarding the use of these materials. Several hundred pages are devoted to equipment alone, while the pattern shop section is a catalog in itself, and contains detailed descriptions of practically all of the tools and supplies for the patternmaker's use. The section devoted to cupolas contains many tables gleaned from authoritative sources and is replete with information on cupola practice. The core room equipment shown covers every possible requirement, while the mills and sand blasting devices for the cleaning room are likewise extensively treated. The molding machine is also given special attention, and many types for various classes of work are shown. Hoists, cranes, overhead conveying systems, etc., comprise another chapter, while molders' tools are described at length. Valuable tables pertaining largely to foundry work, together with many mixtures for the brass foundry are spread over 25 pages. The catalog is well bound in cloth and has an illuminated cover depicting a molder blacking a mold.

ANNEALING FURNACE.—A rotary annealing and hardening furnace for brass, copper, steel, iron, aluminum, gold, silver and other metals, which can be operated by oil or gas as fuel, is described in an 8-page folder issued by the W. S. Rockwell Co., 50 Church street, New York City. The material is charged into the hopper of this furnace in bulk and is conveyed through the chamber automatically to the discharge end where it reaches its ultimate temperature. When the furnace is used for hardening, a quenching tank is fitted below the discharge spout, the tank containing a conveyor operated by the furnace drive, so that as the material is discharged from the furnace into the hardening bath it is caught on the conveyor, brought out and discharged over the end of the tank into a truck or wheelbarrow. The furnace is intended for handling small pieces of like dimensions, such as cartridge shells, eyelets, ferrules, buttons, caps, cups, coin blanks, screws, rivets, springs, nuts, etc.

PATTERN SHOP SUPPLIES.—In bulletin D-9, the Cleveland Galvanizing Works Co., Cleveland, describes its complete line of pattern letters made of white metal and brass, and numerous illustrations, showing the various faces in which the letters are made are included. Burning brands for stamping patterns are also shown, together with leather fillet, fillet tools, brass dowels, shrinkage rules for patternmakers, corrugated fasteners, rapping plates, etc.

ECONOMIZERS.—The B. F. Sturtevant Co., Hyde Park, Mass., in bulletins 161 and 163, describes installations of its fuel economizers in the power plants of large textile mills as well as some of the large steel mills. The bulletins are handsomely illustrated, and the general arrangement of these plants is described in detail.

TOOLS AND MACHINERY.—The 1909 catalog issued by the Brown & Sharpe Mfg. Co., Providence, R. I., is, as usual, complete in every detail, contains 551 pages and should prove a valuable work for not only machine shops but manufacturing plants generally. The index is well arranged and the lines of tools described include milling, grinding, automatic gear cutting and screw machines, cutters, accurate test tools and machinists' tools.

CRANES, MAGNETS AND BUCKETS.—The Browning Engineering Co., Cleveland, in bulletins Nos. 31, 34 and 35, illustrates and describes the uses and applications of lifting magnets, automatic buckets and locomotive cranes which it manufactures.

RECORDING INSTRUMENTS.—Bulletin No. 103, issued by the Bristol Co., Waterbury, Conn., describes recording instruments adapted for blast furnace work, including recording pressure gages, recording thermometers, electric time recorders and indicating and recording, electric pyrometers.

PUMPS.—The International Steam Pump Co., New York City, has issued three bulletins, Nos. 165, 166 and 169, which illustrate and describe Worthington volute centrifugal pumps for low-head service, triplex house tank pumps and boiler feed pumps of the pot valve pattern for heavy pressure.

CORE ROOM EQUIPMENT.—The Falls Rivet & Machine Co., Cuyahoga Falls, O., has issued an 8-page addition to its catalog, which is devoted to a description of the Wadsworth sand mixing and compounding mill, illustrated and described in the May, 1909, issue of THE FOUNDRY; core cutting-off and coning machines, as well as the Wadsworth standard core prints and cabinets for the same.

AIR AND GAS COMPRESSORS.—The Ingersoll-Rand Co., New York City, in a recently issued bulletin illustrates and describes its line of air and gas compressors, and an interesting historical sketch regarding the efforts made by this concern in solving the problems of compressor economy is also given. Two other bulletins describe telescope feed, hammer drills, as well as electric-air track channelers.

CRUCIBLES AND GRAPHITE PRODUCTS.—The Jonathan Bartley Crucible Co., Trenton, N. J., has published a handsomely illustrated, 24-page catalog devoted to a description of crucibles and other graphite products for foundry use, made by this concern. In addition to its regular line of standard crucibles, this company manufactures retorts, graphite phosphorizers, crucible covers, stirrers, skimmers, special crucibles for tilting furnaces, stoppers, nozzles and sleeves. One chapter is devoted to hints on the proper handling of crucibles, and this should prove of special value to every foundrymen inasmuch as it covers the subject of annealing, the proper design and handling of tongs, soaking, etc. The method of mining, sorting and polishing graphite in Ceylon is described and illustrated with numerous views of the natives at work.

MINING MACHINERY.—The Webster & Perks Tool Co., Springfield, O., has issued a 16-page pamphlet illustrating and describing its complete line of grinding and polishing machinery.

THERMIT REPAIRS.—The Goldschmidt Thermit Co., Jersey City, N. J., has issued a 20-page booklet illustrating various repair jobs on which thermit was used successfully. These include the welding of miscellaneous iron and steel castings, rails, anchors, dredge buckets, water wheels, large gears, fly wheels, etc.

SEAMLESS STEEL TUBES.—The National Tube Co., Pittsburg, has issued a handsomely illustrated, 46-page catalog, which is devoted to a description of Shelby cold-drawn seamless steel tubes, where they are made and how they are used. Special photographic views of the various processes of manufacture are included, as well as numerous halftone engravings of the plants operated by this concern.

PUMPS.—In catalog No. 72, Dean Bros. Steam Pump Works, Indianapolis, illustrates and describes its line of hydraulic pressure pumps. Duplex, horizontal, power-driven hydraulic pumps are also shown for 1,500 pounds working pressure per square inch.

PORTABLE CRANES.—A small folder is being distributed by William S. Nicholls, 253 Broadway, New York City, describing the Hercules portable crane hoist, which is built in four sizes and in capacities from 500 to 3,000 pounds.

RECORDING GAGES.—The Bristol Co., Waterbury, Conn., in bulletin No. 102, illustrates and describes a partial list of recording pressure and vacuum gages. Numerous charts are also reproduced.

GENERAL INDUSTRIAL NOTES

The Maxwell-Briscoe Motor Co., Tarrytown, N. Y., will shortly begin the erection of a brass foundry of sufficient capacity to provide for the requirements of this plant. For the present, a brass department will only be installed for an output of about 3,000 pounds daily. It is the intention to later install furnaces for melting aluminum.

The foundry operated by the late Wm. Mann, Martin's Ferry, O., has been purchased by James H. Beans, who will continue to operate the plant. Mr. Beans was formerly connected with the Center Foundry & Machine Co., Martin's Ferry, and has severed his connection with that concern.

The Monarch Foundry Co., Detroit, has increased its capital from $15,000 to $25,000.

The casting of pipe was resumed at the plant of the Central Foundry Co., Anniston, Ala., on May 3. A new record in plant reconstruction was made in rebuilding these works inasmuch as all of the various departments were completed in a period of a little more than three weeks. The main foundry building is 120x500 feet, cleaning room, 46 x 90 feet, and cupola house, 60 x 85 feet.

The Ashton Valve Co. will shortly move from Boston to its new works at East Cambridge, Mass. The main building of the plant is 50 x 200 feet and the foundry, 30 x 60 feet.

The Globe Malleable Iron Co., Syracuse, N. Y., has recently equipped a chemical laboratory for use in connection with its experimental department.

The Vesper Safety Clevis & Malleable Iron Co., Vesper, Wis., is erecting a new foundry, most of the equipment for which has already been purchased.

The Temple Foundry & Machine Co., Temple, Tex., has been organized with $10,000 capital to succeed Brokelmeyer & Bracken. H. Brokelmeyer is president; Edward Winston, vice president and B. L. Gilliam, secretary and treasurer.

The Minneapolis Crucible Steel Co., Minneapolis, is building a steel foundry in Columbia Heights, a Minneapolis suburb. Six crucible furnaces will be installed with provision for additional capacity as required. The machinery equipment includes sand blast and grinding machines, as well as molding machines.

The Indiana Foundry Co., Ltd., Indiana, Pa., which recently extended its foundry 20 x 100 feet, has installed machines for molding bell traps and similar castings.

The Coe Brass Co., Torrington, Conn., one of the constituent companies of the American Brass Co., has purchased the mill buildings of the Warrenton Woolen Co., together with power plant and water privileges. As yet this concern has made no plans for utilization of the property.

The Maumee Foundry Co., Toledo, O., has been organized to take over the business of the Ohio Foundry Co., which has been engaged in the manufacture of gray iron and brass castings during the past four years. The officers of the new concern are as follows: Geo. B. Carr, president and treasurer; Wm. Poucher, secretary; Fred Poucher, general manager.

L. A. Ayers, Omaha, Neb., has equipped a brass foundry, which will shortly be placed in operation. Mr. Ayers' present address is 4027 Seward street.

The Oil City Brass Works has been established at 647 Main street, Beaumont, Texas, by A. Daugherty. A jobbing brass foundry will be operated and a specialty will be made of propellers.

The Latrobe Foundry Co., Baltimore, recently organized by Fred D. Latrobe, Jr., and John C. Shave, has leased the plant of the S. G. Kugler Co., Allen and Clement streets. The foundry is equipped to produce both gray iron and brass castings.

The American Radiator Co., Chicago, has leased the plant of the Birmingham Pipe & Casting Co., Birmingham, and while no improvements have yet been undertaken, it is probable that, following an increase in the demand for radiators, the plant will be placed in operation.

Foundry building No. 2, comprising about one-half the capacity of Geo. H. Thatcher & Co., Albany, N. Y., leased a short time ago to J. A. Kilpatrick, manager of the Canada Iron Corporation, will be operated by the Albany Car Wheel Co., incorporated with a capital of $100,000. The plant is now being equipped for the manufacture of cast iron car wheels.

Yahnig & Cohoon are operating a brass foundry at 77 North street, Bristol, Conn., formerly occupied by the Goodenough Brass Foundry. This concern makes a specialty of brass, composition and aluminum castings.

The Aluminum Goods Mfg. Co., New York City, recently organized with a capital of $750,000, is a consolidation of the Manitowoc Aluminum Novelty Co., Manitowoc, Wis., the Aluminum Mfg. Co., Two Rivers, Wis., and the New Jersey Aluminum Co., Newark, N. J. These concerns make a specialty of aluminum castings of all kinds, especially cooking utensils. Officers have been elected as follows: G. A. Kruttschnitt, president; Joseph Koenig and Geo. Vits, vice presidents and James C. Coleman, secretary and treasurer.

The Pratt Mfg. Co., Cincinnati, is preparing to locate in its new foundry and has ordered

four Fisher furnaces for the melting of brass.

The Henry W. Legel Brass Works, Kansas City, Mo., recently placed in operation, will produce a full line of plumbers' supplies, as well as all kinds of brass and aluminum castings. Henry W. Legel, proprietor, was superintendent of the plant of the Crampton-Farley Brass Co., Kansas City, for a period of nine years.

The Cheyenne Foundry & Machine Co., Cheyenne, Wyoming, has been organized for the purpose of operating a foundry located at 2112 Bent street. It has been placed under the management of F. Sparks and will be remodeled and equipped with modern machinery.

The capital stock of the Standard Pattern & Mfg. Co., Richmond, Ind., has been increased to $20,000.

The Belle City Steel Castings Co., Racine, Wis., recently changed its name to the Racine Steel Castings Co.

The Loomis Brass Foundry has been organized at Akron, O., with $10,000 capital by M. E. Morris, W. R. Price, John M. Rowley, J. P. Loomis and N. E. Thomas.

The Custer Sandless Casting Co. has been organized at Philadelphia for the purpose of holding the various patents issued to Edgar A. Custer on the casting of metals in permanent molds, as well as those now pending. The newly incorporated concern will issue licenses for the use of these patents.

The Hodgson Foundry Co. has been incorporated with a capital of $10,000 and succeeds the firm of John Hodgson & Co., 1069 West 13th street, Chicago, producers of brass, bronze and aluminum castings. The addition of a finishing department for machining brass and bronze castings is under consideration. The directors of the company include John, John W., Robt. G. and Stephen G. Hodgson.

The firm of J. E. Lonergan & Co., 211-213 Race street, Philadelphia, has been incorporated with $200,000 capital under the firm name of the J. E. Lonergan Co. Officers have been elected as follows: John E. Lonergan, president; M. A. Hudson, vice president; H. S. Whitney, secretary, and W. E. Crofton, treasurer. This concern makes a specialty of steam goods and operates a large brass foundry.

The control of the Benton Harbor Malleable Co., Benton Harbor, Mich., recently changed hands and officers have been elected as follows: W. H. Lutz, president; G. S. Burtis, vice president; H. S. Gray, secretary, and J. N. Klock, treasurer and general manager.

The Donaldson Iron Co., Emaus, Pa., expects to operate its new pipe foundry early in the summer months. The shop built last year is 100 x 200 feet and is equipped for producing 24, 30 and 36 inch cast iron pipe.

New Construction.

The Pennsylvania Foundry Co., York, Pa., will reorganize and incorporate under the same name with a capital of $30,000. A foundry 100 feet square, of brick and steel construction, will be erected, as well as a two-story pattern shop, 40 x 60 feet, and an office building, 20 x 24 feet. This concern manufactures gray iron and brass castings, giving special attention to automobile castings.

The Witte Iron Works, Kansas City, Mo., is erecting a new foundry and pattern shop.

The Wm. A. Rogers Co., Ltd., silverware manufacturer, Niagara Falls, N. Y., will increase its electroplating plant by the erection of an addition, three stories high, 80 x 181 feet, and the boiler house will be extended 29 x 46 feet.

Contracts have been awarded by the T. H. Symington Co., Baltimore, Md., for the erection of a new plant at Lincoln Park, Rochester, N. Y. The contract provides for the erection of a foundry of steel frame construction, 422 x 456 feet; machine shop, three stories, 34 x 150 feet, and an office building two stories, 64 x 38 feet.

The Southern Stove Works, Evansville, Ind., will erect a new stove plant covering five acres, and the old plant will be abandoned as soon as the new foundry is completed.

The Cleveland Foundry Co., Cleveland, is having plans prepared for another addition to its plant, 60 x 200 feet and five stories high.

A large plant for the manufacture of car wheels and general mine equipment, will be erected at Bristol, Tenn., by the Enterprise Foundry & Machine Works of that city. The foundry will be erected at Shelby street and the Virginia & Southwestern railroad, and will be erected to supply the territory that is being opened by the Carolina, Clinchfield & Ohio, Louisville & Nashville, Virginia & Southwestern and Virginia railroads. Asa W. Whitney, who for seven years was connected in an official capacity with the Sanford-Day Iron Works, Knoxville, Tenn., has become interested in the new enterprise.

The Wheeling Mold & Foundry Co., Wheeling, W. Va., will add a steel department to its gray iron foundry, and has decided to install a 20-ton open-hearth furnace.

The Pittsburg Motor Truck Co. has been incorporated with a capital of $100,000, and will erect a plant at Koppel, Pa. The main building will be 50 x 150 feet, two stories high and the foundry will be 40 x 80 feet.

The Philadelphia Roll & Machine Co., Philadelphia, will erect a new roll and machine shop. The structure will be 60 x 120 feet, with a lean-to extending north and south. When these additions are completed the foundry will be 50 x 328 feet, and will be served by two overhead electric traveling cranes and three large air furnaces will be provided for melting purposes.

The Inland Steel Casting Co., Terre Haute, Ind., recently incorporated with $50,000 capital, will erect a foundry 100 x 250 feet, near the plant of the Terre Haute Malleable Iron Works.

The Malleable Iron Range Co., Beaver Dam, Wis., will erect an L-shaped foundry, one section of which will be 70 x 210 feet and the other, 70 x 270 feet. A two-story brick factory building, 60 x 170 feet, will also be built.

The Minsching Brass Foundry, Milwaukee, is having plans prepared for an addition to its plant.

Willard A. Van Brunt, Horicon, Wis., is considering the erection of a foundry for the manufacture of gray iron castings for agricultural implements.

The Iowa Stove & Range Co., Waterloo, Iowa, will erect a foundry on the site of the plant formerly owned by the Cascaden Foundry Co. The building will be 80 x 146 feet.

Henry Disston & Sons, Inc., Philadelphia, will erect a two-story pattern storage building, 60 x 100 feet, machine shop 60 x 100 feet and blacksmith shop 60 x 80 feet.

The Michigan Brass & Iron Works, Lansing, Mich., successors to the Walker & Schultz Foundry Co., have been capitalized at $20,000, and will erect a new foundry south of the old one for the manufacture of gray iron, brass and aluminum castings. Officers have been elected as follows: Wm. Walker, president; Clifford K. Gleason, vice president and treasurer, and E. V. Prentice, secretary.

The Bowmanville Foundry Co., Bowmanville, Ont., will make extensive improvements during the summer months, and will erect two buildings, one to be used for a plating and milling department, and the other for pattern storage purposes.

The Lavelle Foundry Co., Anderson, Ind., has increased its capital from $5,000 to $10,000.

The Campbell Iron Co., 617 North Second Street, St. Louis, will erect a new foundry, 123 x 133 feet.

The United States Radiator Co., Dunkirk, N. Y., is having plans prepared for a large addition to its foundry.

The Wilkinson-Knupp Brass Co., Greenville, Pa., is preparing plans for the erection of two new buildings, each 60 x 100 feet.

The National Gear & Foundry Co., Pittsburg, manufacturer of machine-molded gears and gas engines, will erect a reinforced concrete building, 23 x 120 feet, three stories high, which will contain a pattern shop, pattern storage, offices, etc. At present the pattern shop is on the first floor with the foundry and when the former is removed to the new building, foundry facilities will be increased about 25 per cent.

The Southwestern Iron Works, Wellington, Kans., is erecting a foundry for the manufacture of sash weights, post mauls, hitching weights, etc. The main building will be 40 x 75 feet. Additional machinery will be purchased in the spring, and in the meantime this concern would like to receive catalogs from manufacturers of foundry equipment.

J. A. Kilpatrick, manager of the Canada Iron Corporation, Ltd., Montreal, has leased a part of the plant of the Thatcher Car Wheel Co., Albany, and is organizing a new concern which will be known as the Albany Car Wheel Co., to operate the plant. Within the next three or four months, or as soon as the shop can be overhauled, the new company will begin operations. The Albany plant will have no connection with the Canadian interests of the corporation above named.

The Enz & Orr Foundry Co., Denver, Colo., has been incorporated with a capital of $25,000, and succeeds the firm of Enz & Orr.

The Brookside Brass & Foundry Mfg. Co., Cleveland, has increased its capital stock from $10,000 to $20,000.

The Vulcan Foundry Co., Hamilton, O., has been reorganized with a capital of $40,000 and the firm name has been changed to the Miami Foundry Co. Officers have been elected as follows: James K. Cullen, president; V. W. Cullen, vice president; Russell Andrews, secretary and Howard Stevenson, treasurer.

The Royal Brass Mfg. Co., has completed a new plant on East 43rd Street, Cleveland, for the manufacture of plumber's goods. It consists of a foundry, 30 x 50 feet, and a finishing shop, 40 x 120 feet. B. H. Jasen is president and general manager and N. M. Wellman, secretary and treasurer.

The stock of the Calhoun Foundry Co., Anniston, Ala., has been purchased by John M. Stillwell, who will continue to operate the plant for the manufacture of sash weights and light castings.

The foundry operated by G. Walter Green, at Peterboro, Can., has been incorporated under the firm name of the G. Walter Green Co., with a capital stock of $100,000.